73 for Radio Amateurs®

A WGE Publication

April 1986
$2.50 USA
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Issue #307

DAYTON '86

Will W2NSD/1 Steal the Show?

Exotic Antennas

- Invisible 2m Vertical
- Europe's Famous GP— How Does It Work?
- Stacked Vee Beams for HF
- Curved Linear Arrays

Product Focus:

Tonna 55-element 1296-MHz Yagi

plus:

- Computerized Morse
- Simple FT-101E Mod
- Basic RTTY
- Microwave Converter

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ANN ARBOR MI 48106

74470 65946 0

NEW!

ICOM HF Transceiver

IC-735

Ultra Compact

The new ICOM IC-735 is what you've been asking for...the most compact and advanced full-featured HF transceiver with general coverage receiver on the market. Measuring only 3.7 inches high by 9.5 inches wide by 9 inches deep, the IC-735 is well suited for mobile, marine or base station operation.

More Standard Features

Dollar-for-dollar the IC-735 includes more standard features...FM built-in, an HM-12 scanning mic, FM, CW, LSB, USB, AM transmit and receive, 12 tunable memories and lithium memory backup, program scan, memory scan, switchable AGC, automatic SSB selection by band, RF speech processor, 12V operation, continuously adjustable output power up to 100 watts, 100% duty cycle and a deep tunable notch.

Superior Performance

It's a high performer on all the ham bands, and as a general coverage receiver, the IC-735 is exceptional. The IC-735 has a built-in receiver attenuator, preamp and noise blanker to enhance receiver performance. PLUS it has a 105dB dynamic range and a new low-noise phase locked loop for extremely quiet rock-solid reception.

Options. A new line of accessories is available, including the AT-150 electronic, automatic antenna tuner and the switching PS-55 power supply. The IC-735 is also compatible with most of ICOM's existing line of HF accessories.

Simplified Front Panel

The large LCD readout and conveniently located controls enable easy operation, even in the mobile environment. Controls which require rare adjustment are placed behind a hatch cover on the front panel of the radio. VOX controls, mic gain and other seldom used controls are kept out of sight, but are immediately accessible.

See the IC-735 at your authorized ICOM dealer. For superior performance and innovative features at the right price, look at the ultra compact IC-735.

ICOM

First in Communications

ICOM America, inc., 2380-116th Ave NE, Bellevue, WA 98004 / 3331 Towerwood Drive, Suite 307, Dallas, TX 75234

All stated specifications are approximate and subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. 735485

HAM RADIO OUTLET

NEW OAKLAND LOCATION

6 STORE BUYING POWER

ICOM IC-R71A

Superior Grade General Coverage Receiver

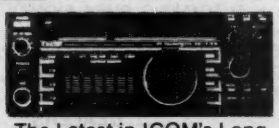
SALE! CALL FOR PRICE

ICOM IC-37A

IC-27A (25W,2M,FM)
IC-27H (45W,2M,FM)
IC-37A (25W,220MHz,FM)
IC-47A (25W,70cm,FM)

CALL FOR LOW, LOW PRICE

ICOM IC-735



The Latest in ICOM's Long Line of HF Transceivers

CALL FOR LOW, LOW PRICE

ICOM IC-3200A

DUAL BANDER

Covers Both 2 Meters & 70 cm

LATEST EDITION

ICOM IC-2KL

LINEAR AMPLIFIER

- Auto Band Switching
- Broadbanded
- HF 500 Watt Linear

AT GREAT LOW, LOW PRICES

ICOM IC-R7000

25 MHz-1300 MHz

NOW TAKING ORDERS FOR FIRST SHIPMENT

ICOM IC-1271A

NEW

1.2 GHz Transceiver: The First Full-featured 1240-1300 MHz Transceiver

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ICOM HAND-HELDS

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IC-04AT

IC-2AT
IC-4AT

IC-3AT

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MasterCard VISA

THINGS TO LOOK FOR *(AND LOOK OUT FOR)* IN A PHONE PATCH

- One year warranty.
- A patch should work with any radio. AM, FM, ACSB, relay switched or synthesized.
- Patch performance should not be dependent on the T/R speed of your radio.
- Your patch should sound just like your home phone.
- There should not be any sampling noises to distract you and rob important syllables. The best phone patches do not use the cheap sampling method. (Did you know that the competition uses VOX rather than sampling in their $1000 commercial model?)
- A patch should disconnect automatically if the number dialed is busy.
- A patch should be flexible. You should be able to use it simplex, repeater aided simplex, or semi-duplex.
- A patch should allow you to manually connect any mobile or HT on your local repeater to the phone system for a fully automatic conversation. Someone may need to report an emergency!
- A patch should not become erratic when the mobile is noisy.
- You should be able to use a power amplifier on your base to extend range.
- You should be able to connect a patch to the MIC and EXT. speaker jack of your radio for a quick and effortless interface.
- You should be able to connect a patch to three points inside your radio (VOL high side, PTT, MIC) so that the patch does not interfere with the use of the radio and the VOL. and SQ. settings do not affect the patch.
- A patch should have MOV lightning protectors.
- Your patch should be made in the USA where consultation and factory service are immediately available. **(Beware of an inferior offshore copy of our former PRIVATE PATCH II.)**

ONLY
PRIVATE PATCH III
GIVES YOU ALL
OF THE ABOVE

PRIVATE PATCH III
SIMPLEX SEMI-DUPLEX INTERCONNECT

The telephone is the most powerful mode of communications . . . PRIVATE PATCH III gives you full use of your home telephone from your mobile and HT radios!

With only three simple connections to your base station radio, PRIVATE PATCH III will give you more communications power per dollar than you ever imagined possible.

Suddenly the utility of your radio is drastically increased. There are new sounds . . . dial tones, ring tones, CW ID and the sound of voices you never expected to hear on your mobile or HT radio! What a convenience!

PRIVATE PATCH III frees you from memberships, cliques and other hassles common to many repeater autopatches. You can call who you want, when you want and for as long as you want. You can even receive your incoming calls!

VOX . . . the right choice!

VOX based phone patches offer many performance and operational advantages over the sampling method. These include operation through repeaters, compatibility with any radio, no lost words or syllables, greater range, smooth audio free of continual noise bursts, etc., etc.

Most amateurs are not aware that the competition's top of the line patch is VOX based. (You know . . . the $1000 model they enthusiastically call **"our favorite commercial simplex patch"** on page 3 of their SP brochure.)

PRIVATE PATCH III offers about the same capability, performance and features as their top model but is priced closer to their bottom of the line (SP) model!

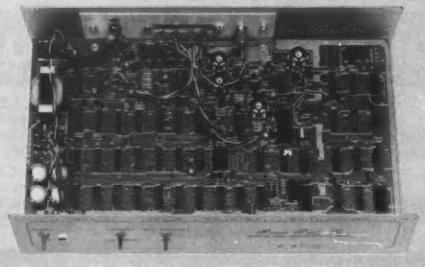
So why settle for SP when top of the line costs little more?

To Learn more about PRIVATE PATCH III and the advantages of the VOX concept, call or write for our four page brochure today!

PARTIAL LIST OF FEATURES

• OPERATES SIMPLEX, THROUGH REPEATERS, OR DUPLEX ON REPEATERS • VOX BASED • TOLL RESTRICT (Digit counting and programmable first digit lockout) **• SECRET CODE DISABLES TOLL RESTRICT FOR ONE TOLL CALL**—Automatic re-arm **• AUTOMATIC BUSY SIGNAL DISCONNECT • CONTROL INTERRUPT TIMER** (Maintains positive mobile control) **• CW ID** When you connect again on disconnect. Free ID chip. **• SELECTABLE TONE OR PULSE DIALING • MOV LIGHTNING PROTECTORS • THREE DIGIT ACCESS CODE** (e.g. ★91) **• RINGOUT** (Reverse patch) Ringout inhibit if channel busy. **• RESETTABLE THREE MINUTE TIMER • SPARE RELAY POSITION • 115VAC SUPPLY**

Options:
FCC approved coupler
12 VDC or 230 VAC power



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73 for Radio Amateurs®

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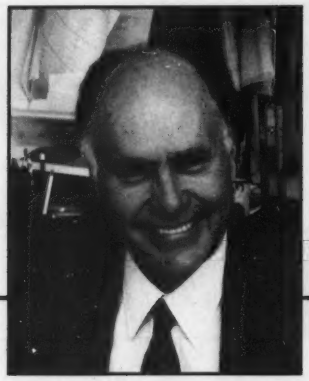
NEVER SAY DIE



A long about 33 years ago I started a column in *CQ* on RTTY. Yep, I was into digital communications that long ago, for those of you who thought digital was something new. I thought I'd mention that before I tell you I'm looking for some really active hams to do some columns for *73*.

Columns on some special ham interest usually start out like gangbusters, but after a while the columnist usually runs out of steam. As an ex-columnist I know all about that side of the street.

So what I'd like to do is have the best of both worlds—cake and eat it too division. I'd like to see some experts tackle subjects that I know can be very interesting—such as RTTY, SSTV, packet radio, repeaters, UHF, antennas, DXing, ham clubs, mobile, contests, certificate hunting, QRP, facsimile, traffic handling, nets, home construction, and so on. I'm talking about having short, interesting columns—some monthly, some bimonthly—for each special ham interest.

This is the catch: I'll be asking you to vote every month on which columns you enjoy and which you find boring. If a column doesn't make the grade with you, it's out.

Since thousands of hams are interested in every one of the facets of our hobby I mentioned, a columnist should be able to make every column a winner. If I'm able to find someone to report on your particular interest and you allow the column to become boring, you'll lose it. You'll also lose the opportunity for getting a few thousand more hams involved with your special interest—and the opportunity to attract manufacturers to your interest.

If you would like to try out for a column, and for fame and fortune (well, fame, anyway), the route to stardom is simple. First drop me a line explaining what special ham interest you want to write about. Then tell me about your background and why you are the ideal person to tackle this. Third, I'd like to have an idea of your resources: what you've accomplished, who you know, what ham manufacturers may help you, and so on. Fourth, I need to see a couple of sample columns. I warn you, I'm going to read them lying in bed, dead tired. Either you keep me awake in a fever pitch of excitement and get the contract, or I'll save your columns for when I have insomnia.

I do expect you to have a working knowledge of grammar and to either own a dictionary (which you use) or have a spelling checker in your word processor. Once we get started I'll expect to get your material well before deadlines—preferably via a floppy disk or, better, via modem. We're totally automated here, so we don't re-keyboard stuff any more. It all comes in from our writers' computers.

The columns don't pay enough for you to do all that work for the money. We pay around $100 or so, enough to buy a little extra ham gear. The columns should be fairly short, maybe two or three double-spaced printout pages. We're not looking for the Great American Novel; we want to get excited about amateur radio.

One extra spiff, in case you haven't thought about it. Surveys of past authors have shown that being published in a technical journal such as *73* can help substantially when you are looking for a raise or a better job. In general, the rule is that your salary will go up about $1,000 per year for each article you have published. I'll bet it never occurred to you why so many hams were writing articles for ham magazines. There is more than their love of the hobby involved, though that doesn't hurt.

TNS=THE NEW SIX?

Unless you've been holed up in the back of your ham shack, cut off from the real world by an

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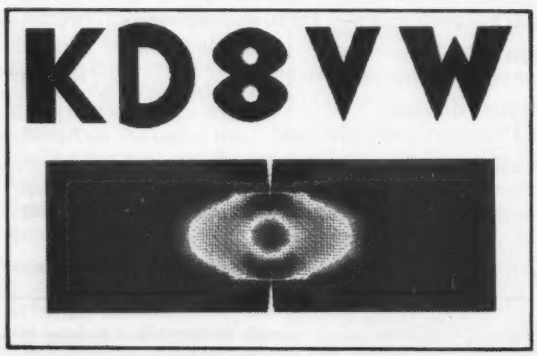

QSL OF THE MONTH

KD8VW's card represents a finite-element analysis of a double-cracked test specimen. The colors show stress patterns. The figure was produced by a VAX 11-785 computer on a Tektronix 4115 terminal.

To enter your QSL, mail it in an envelope to *73*, WGE Center, 70 Rte. 202 N., Peterborough NH 03458, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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KENWOOD

pacesetter in Amateur radio

NEW! Computer Interface!

Complete Control...

IF-232C Level translator

IF-10A Computer interface for TS-711A/TS-811A
IF-10B Computer interface for TS-940S
IC-10 IC kit for TS-440S computer control

Attention "computing" hams! The Kenwood IF-Series computer interface units will enable you to connect your TS-711A, TS-811A, TS-940S, or TS-440S transceivers to your home computer. RS-232C standard is used, so the interface units are compatible with any computer!

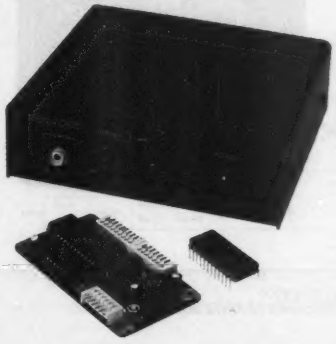
The IF-10A and IF-10B computer interface boards and IC-10 IC kit are designed to be installed inside the transceivers. Control is performed via the computer RS-232C port and through the IF-232C level translator. The level translator performs two functions: (1) converts voltage levels from the RS-232C port to the TTL levels in the transceiver, (2) and acts as a noise supressor. A complete interface "kit" would include the appropriate computer interface units (IF-10A, IF-10B, or IC-10) and the IF-232C level translator.

The applications of automated station control are almost endless! Just imagine...work DX from your hand-held...operate OSCAR "automatically"...remote operation of your station...or put together the "ultimate" contest station....

Short Wave Listener's map and directory—simply select the QTH you'd like to listen to, and the pre-programmed frequency is "dialed up."

Display frequency, band, and mode data. Control your rig via keyboard!

- **Interchangeable commands**
  This means that one program may be used with several rigs, to minimize program changes.
- **Simultaneous operation of the computer and transceiver is possible**



- **Powerful, easy-to-understand instruction set**
- **Wide variety of commands**
  Memory input and recall, frequency selection, frequency step, sub-tone frequency, offset, antenna tuner, DCS, scan, and many, many more functions are accessible with the Kenwood computer interface unit!
- **AC-10 AC power adapter (optional)**

More IF-232C and computer interface information is available from authorized Kenwood dealers.

CRT display shown is a sample program, not available from Trio-Kenwood Communications.

Complete service manuals are available for all Trio-Kenwood transceivers and most accessories. Specifications and prices are subject to change without notice or obligation.

25th Anniversary

KENWOOD

TRIO-KENWOOD COMMUNICATIONS
1111 West Walnut Street
Compton, California 90220

KENWOOD

pacesetter in Amateur radio

The Smallest HT!

TH-21AT/31AT/41AT

Kenwood's advanced technology brings you a new standard in pocket/handheld transceivers!

- **High or low power.** Choose 1 watt high—enough to "hit" most local repeaters; or a battery-saving 150 mW low.
- **Pocket portability!** Kenwood's TH-series HTs pack convenient, reliable performance in a package so small, it slips into your shirt pocket! It measures only 57 (2.24) W x 120 (4.72) H x 28 (1.1) D mm (inch) and weighs 260 g (.57 lb) **with PB-21.**
- **Expanded frequency coverage (TH-21AT/A).** Covers 141.000-150.995 MHz in 5 kHz steps, includes certain MARS and CAP frequencies.
  TH-31AT/A: 220.000-224.995 MHz in 5 kHz steps.
  TH-41AT/A: 440.000-449.995 MHz in 5 kHz steps.

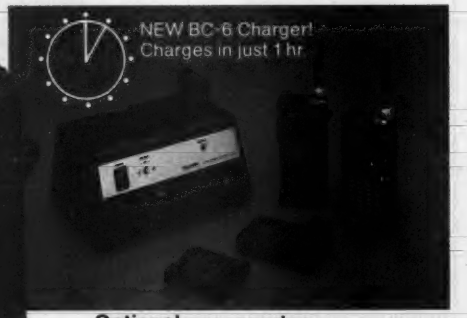
- **Easy-to-operate, functional design.** Three digit thumbwheel frequency selection and handy top-mounted controls increase operating ease.

- **Repeater offset switch.**
  TH-21AT/A: ±600 kHz, simplex.
  TH-31AT/A: −1.6 MHz, reverse, simplex.
  TH-41AT/A: ±5 MHz, simplex.
- **Standard accessories:** Rubber flex antenna, earphone, wall charger, 180 mAH NiCd battery pack, wrist strap.

NOW! Extended-life battery pack

- **Quick change, locking battery case.** The rechargeable battery case snaps securely into place. Optional battery cases and adapters are available.
- **Rugged, high impact molded case.** The high impact case is scuff resistant, to retain its attractive styling, even with hard use.

See your authorized Kenwood dealer and take home a pocketful of performance today!



Optional accessories:

- **HMC-1** headset with VOX
- **SMC-30** speaker microphone
- **PB-21** NiCd 180 mAH battery
- **PB-21H** NiCd 500 mAH battery
- **DC-21** DC-DC converter for mobile use
- **BT-2** manganese/alkaline battery case
- **EB-2** external C manganese/alkaline battery case
- **SC-8/8T** soft cases
- **TU-6** programmable sub-tone unit
- **AJ-3** thread-loc to BNC female adapter
- **BC-6** 2-pack quick charger
- **BC-2** wall charger for PB-21H
- **RA-8A/9A/10A** StubbyDuk antenna
- **BH-3** belt hook

KENWOOD

TRIO-KENWOOD COMMUNICATIONS
1111 West Walnut Street
Compton, California 90220

TH-series transceivers shown with optional StubbyDuk antenna. TH-31AT shown with PB-21H.
Specifications and prices are subject to change without notice or obligation.
Complete service manuals are available for all Trio-Kenwood transceivers and most accessories.

QRX . . .

EDITED BY PERRY DONHAM KW1O

But, Nooo . . .

SOME PEOPLE OUT THERE apparently don't appreciate all the hard work put in by amateur volunteers to ensure continuous communications during an emergency. In a letter to the Cellular Telecommunications Industry Association, **Martin Hertz** (!) of the **Communications Attorney Service**(founded by Richard Cooper) attempted to prove "that the American Radio Relay League and its ham-radio followers are trying to undermine the legitimate commercial radio interests." Attached to the letter was a copy of a story (from *WorldRadio*) which chronicled the exploits of a group of hams who provided a large hospital with emergency communications after the facility's telephones went dead. Hertz believes that this type of assistance is contrary to Part 97 of the FCC Rules and Regulations and points out that, "We in the CAS cannot believe that those who organized [this] radio fiasco could not locate hundreds of thousands of Part 95 licensed Citizens Radio operators to fulfill this duty legally." Finally, the CAS asked the CTIA for "support in neutralizing both the American Radio Relay League and its followers." The Old Man would have applied liberal doses of Wouff Hong to these guys!

Kiri On

T32 EASTERN KIRIBATI will be active during this year's *CQ* WPX SSB test. **Junichi Tanaka JH4RHF** reports that a group of four will make the trip; operation will begin on March 26 and continue through April 2. Look for the DXpedition on all bands, CW and SSB, before the contest. QSLs go to Junichi Tanaka JH4RHF, 146 Kotobuki, Hattori, Toyonaka, Osaka 561, Japan.

Money Matters

TWENTY-ONE SCHOLARSHIPS are available for college-bound hams for the 1986–87 academic year. The scholarships, administered through the **Foundation for Amateur Radio (FAR)**, are sponsored by the Quarter Century Wireless Association, the Dade (Florida) Radio Club, the Baltimore Amateur Radio Club, the Department of State Amateur Radio Club, Radio Club of America, the Richard G. Chichester memorial, the Young Ladies' Radio League, the Edmund Redington Memorial, the Amateur Radio News Service, and the Columbia (Maryland) Amateur Radio Association. Awards range from $350 to $900. Applications and information are available from FAR Scholarships, 6903 Rhode Island Ave., College Park MD 20740—your request must be postmarked prior to May 31, 1986.

Carib Hams QSY

CARIBBEAN AMATEURS may now use voice communications on 7.075–7.100 MHz. The new rule, which went into effect at the end of February, allows hams with General, Advanced, or Extra tickets to use the new segment. The reason for the change is the heavy broadcast interference present from 7.1–7.3 MHz, which renders the band nearly useless during the evening hours. **David Novoa** started the ball rolling back in 1984 with a petition that asked for parity with other Caribbean nations. Most emergency and service activity in the area is located below 7.1 MHz, and, under the old rule, U.S. amateurs couldn't participate in these nets. The FCC felt that the number of potential users of the new segment was so small that additional interference to non-voice communication in the segment would be minimal.

Atari Trick

WOODY GRIGGS WA4NZO has come up with a simple trick for Atari 800XL owners who would like to use Kantronics' Hamsoft RTTY program:

1. Turn your 800XL and disk drives off.
2. Turn on the disk drive.
3. Place a "Transiator" disk in the drive.
4. Turn on the computer—do *not* hold down the option key.
5. Once the machine has booted, replace the Translator disk with a DOS 2.0 disk (there should be no auto-run program present).
6. (Here's the tricky bit!) *Carefully* plug the Hamsoft cartridge into the 800XL. If you see garbage on the screen, don't panic!
7. Hit the reset button. Hamsoft is now ready to use.

Planned Band

A NEW BAND PLAN for 902–928 MHz has been adopted by the **Southern California Repeater and Remote Base Association (SCRRBA)**. Representatives of the major users of the new 33-cm band met in Hollywood to discuss interference from non-amateur radio services, and to debate an equitable distribution of the spectrum. The SCRRBA document parallels the ARRL's interim band plan, making certain adjustments for local operating conditions. If you are interested in how the Association developed its proposal, contact it at PO Box 5967, Pasadena CA 91107.

QSL Via . . .

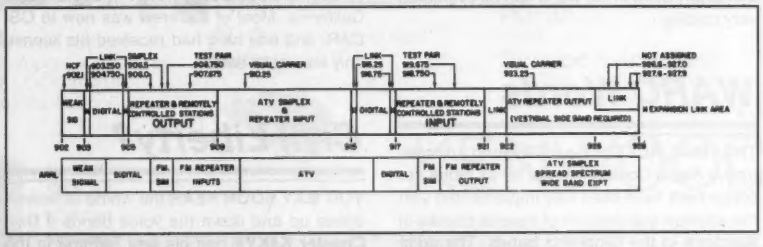
AND NOW a word from **Richard Breckinridge WA9BXB:** "Please be advised that I am now the QSL manager for **Ian Williams VK3MO.**" Richard's address is 3827 Kemman Ave., Brookfield IL 60513.

DARA Dollars

TWO $1,000 SCHOLARSHIPS are available from the **Dayton Amateur Radio Association** (the Hamvention people). Any licensed amateur graduating from high school in 1986 is eligible, and there are no restrictions on the student's planned course of study. To emphasize the importance of clubs to amateur radio, DARA asks that each application be accompanied by the recommendation of a local club officer. (Don't worry if you have no club nearby; just have your form signed by a licensed ham.) Entries must be postmarked no later than May 15, 1986, and the winners will be announced in early June. You can get information and applications by writing to DARA, Box 44, Dayton OH 45401. Attn: Scholarship Committee.

Sat Shoot Set

A NEW OSCAR SATELLITE is scheduled to launch this fall aboard a European Space Agency Arienne 4 booster. The Phase 3C bird will carry four transponders for modes B, J/L, L, and S. Mode B uses the familiar 435-MHz



SCRBBA's band plan for 902–928 MHz (above); ARRL's interim band plan.

uplink and 145-MHz downlink. The transponder for mode J/L operates with either an uplink on 1269 MHz and a downlink on 435 MHz, or an uplink on 144 MHz and a downlink on 435 MHz. Mode L is a PSK digital channel with an uplink on 1269 MHz and a downlink on 435 MHz. Mode S uses a soft-limited FM transponder that also can support up to four SSB signals. The spacecraft currently is being ground tested in a thermal/vacuum chamber made available by Martin-Marietta: The chamber simulates conditions in space, and is used to weed out those components and systems likely to fail in that harsh environment (thus avoiding expensive repair trips later on).

New Sputniks?

WHILE NOT YET CONFIRMED by the Soviets, it appears that two new Russian satellites, **RS-9 and RS-10**, have been successfully launched. AMSAT observers report receiving telemetry from two unidentified spacecraft on and around 29.4 MHz, and are working out the orbital details. RS-9 is identical to earlier RS-series satellites, carrying only a mode A (145 MHz uplink, 29.5 MHz downlink) transponder. RS-10 packs three separate transponders: mode A, mode K (21.3 MHz up, 29.5 MHz down), and mode T (21.3 MHz up, 145 MHz down). RS-10 also carries a beacon that transmits on 145.557 MHz. Expect a low polar orbit for both RS-9 and RS-10, with a period of about 120 minutes.

Begin the Beacon

A WORLDWIDE 10-meter beacon system is being developed by the **International Amateur Radio Union**. IARU Resolution 85-1 is the template for the new network, which will operate in the same manner as the successful 14.1-MHz system sponsored by the Northern California DX Foundation. According to the Resolution, a worldwide net of beacon stations will operate on 28.2 MHz, with each beacon occupying a specific slice of time. In the NCDXF system, beacons transmit an identification followed by four long tones, each tone being transmitted with 6 dB less power (100, 10, 1, and .1 Watts). This takes about a minute—the next one-minute slot is occupied by the next beacon in the network. By strategically locating the beacon stations, propagation to any point in the world can be evaluated very quickly.

WARC Words

THE FINAL ACTS of the 1979 World Administrative Radio Conference (as far as hams are concerned) have been fully implemented with the addition and deletion of several chunks of spectrum in the Gigahertz bands. The adds are: 47 to 47.2 GHz, 76 to 81 GHz, 119.98 to 120.02 GHz, and 142 to 149 GHz. We lost: 1215 to 1240 MHz, 48 to 50 GHz, 165 to 170 GHz, and 240 to 241 GHz. Added to the Amateur Satellite Service are: 1260 to 1270 MHz, 2400 to 2450 MHz, 3.4 to 3.41 GHz, 5.65 to 5.67 GHz, 5.83 to 5.85 GHz, 10.45 to 10.5 GHz, 47 to 47.2 GHz, 75.5 to 81 GHz, 142 to 149 GHz, and 241 to 250 GHz. All of these changes became effective March 1st, 1986, at 0001Z.

Jeepers!

WE'VE MADE A FEW CHANGES in your favorite ham rag. Your constant input has convinced you-know-who that tiny type is just too difficult to read, so you'll find bigger print in *73*'s columns. Feature articles are easier on the eye, too, in their new three-column layout. (For the terminally curious, the typeface has been changed from Oracle to Times.) You'll also notice that Wayne's editorial is back—we had to add a few pages to the magazine to fit it all in! What else is coming? With Wayne at the helm, it's not easy to predict, but read this month's Never Say Die. Be prepared for a few surprises!

RIP RBBS

THE *73* RBBS is currently off-line. With the magazine's move to Hancock, New Hampshire, came the abrupt termination of the board. Sorry about that! We're working on getting a system up in the new offices—meanwhile, you can leave electronic mail for *73* in our mailbox on CompuServe (ID 70310,775).

CQ DX 2m

150 MILLIWATTS was all it took for hams in Chicago, Illinois, to contact both coasts on two meters. Thanks to **Paul Bocci K9NO** and the **Northwest Area Public Service repeater N9CXQ**, 21 Chicago-area hams were able to access OSCAR 10 through a VHF gateway. Paul made the conversion from between FM and SSB, and handled the logistics of maintaining contact with the satellite. Using handhelds and mobile radios, participants worked **Bob Durso N1DOA** in Kingston, New Hampshire, **Joe Justy KA2PRX** in Barnegat, New Jersey, and **Joe Burke K6IBY** in Costa Mesa, California. Most of the crew was new to OSCAR, and one ham had received his license only six weeks earlier.

Civil Liberty?

YOU MAY SOON HEAR the whine of heterodynes up and down the voice bands if **Don Chester K4KYV** has his way. Writing in the *AM Press/Exchange*, Don points out that the rule, which will require users of DSB AM to decrease their power output, will come up for review in 1990, just before the rule takes effect. Don wants AMers to build or buy hundreds of plate-modulated kilowatt amplifiers and use them to "prove" that the power reduction is unfair. (The reduction applies only to plate-modulated class-C amplifiers, of which there are very few.) He also implies that many AMers will simply ignore the FCC regulation and continue to run a full thousand Watts input.

Packet Piked

IS IT CURTAINS for third-party message forwarding via packet radio? The Federal Communications Commission has altered Part 97 to allow automatic control of digital communications systems on frequencies above 50 MHz. All of the mountain-top packet digipeaters in use are now legal. Many comments regarding the NPRM asked that third-party traffic handled via high-speed digital networks be exempt from the rule requiring a control operator to be present while the traffic is being transmitted. Thousands of such messages are passed every week automatically through store-and-forward packet stations (in New England, a significant portion of all NTS traffic is passed this way). The FCC feels that the medium by which a message is transmitted is not important, and so the control operator requirement applies to packet radio. We still can use the packet networks to pass notes between ourselves, but (for now, at least) automatic forwarding of traffic for a third party is *verboten*. The question now is, "Why did we ask permission to do something that we already were doing?"

Stony Path

REACTION to the "Stoner proposal" to create a new low-power, license-free digital service on the high end of the amateur six-meter band has been favorable. Author of the petition **Don Stoner W6TNS** says that comments are two-to-one in favor of the new system; major dissenters are Maximum Service Telecasters and the American Radio Relay League. Is the League miffed because a no-code radio license might pass after all? Or is it the idea of losing more frequencies? Certainly 52–54 MHz could be better utilized. I think that the proposal is a good one, and I wish Don success.

Kudos

THANKS this month to *The AM Press/Exchange*, Bill Itter N9EWA, Bob McKay N8ADA, *The W5YI Report, Gateway*, and Bill Pasternak WA6ITF. Send your snippets of news to *73* Magazine, Wayne Green Enterprises, WGE Center, Peterborough NH 03458, Attn: QRX.

KENWOOD

pacesetter in Amateur radio

Accessories

TL-922A 160-15 m 2 KW PEP/1 KW DC Input Linear Amplifier. Pair of EIMAC 3-500Z tubes and excellent IMD characteristics. Perfect safety protection with blower turn-off delay circuit.

PC-1A Phone Patch (FCC Part 68 registered).

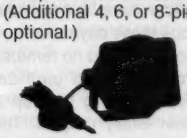
MA-5 80/40/20/15/10 meter mobile antenna. All resonators supplied. 200 W PEP max., VSWR 1.5:1 or less. Easily adjustable for center frequencies.

VP-1 Bumper mount for above.

VB-2530 25 W RF Power Amplifier (for TR-2600A). BNC-BNC cable, and mounting bracket supplied.

MC-85 (8-pin) Multi-function desk-top microphone (8-pin) 700 Ω unidirectional electret condenser mic. Built-in audio level compensation with output and tone control, meter, and UP/DOWN switch. Selector switch for up to three transceivers. (Additional 4, 6, or 8-pin cables optional.)

MC-60A (8-pin) Deluxe desk-top microphone. Pre-amp built-in, PTT, LOCK and UP/DOWN switches. Hi/Lo Z selector switch.



SP-40 Compact mobile speaker.

SP-50 Mobile speaker.

SM-220 Station monitor/10 MHz oscilloscope Pan display capability with optional BS-8 (for TS-940S, TS-830S). Monitor transmitted waveforms and/or received signal waveforms. Built-in 2-tone generator.

HS-5 Deluxe headphones.

HS-6 Lightweight headphones.

LF-30A Low pass filter. 1 kW, 50 Ω. Insertion loss: less than 0.5dB at 30 MHz.

MA-4000 2 m/70 cm dual band mobile gain antenna. Duplexer supplied. Ideal for use with the TW-4000A "Dual Bander" and TM-211A/TM-411A. (Mount not supplied.)

AL-2 Lightning and static arrester. 1 kW, 50 Ω.

Not Shown:

MC-50 Desk-top microphone. Hi/Lo Z. 4-pin connector.

MC-80 Desk-top microphone. 700 Ω unidirectional electret element with flexible boom. Built-in mic. pre-amp and UP/DOWN switch, with lock. (8-pin).

MC-48 Hand microphone with 16-key DTMF pad and UP/DOWN switches. (8-pin).

MC-46 As above, but with 6-pin connector.

MC-42S Hand microphone with UP/DOWN switches. (8-pin).

MC-35S Noise cancelling hand microphone, 50 k Ω (4-pin).

MC-30S As above, but 500 Ω.

PG-4A Microphone cable for MC-60A. Converts MC-60A to 4-pin connector.

PG-4B As above, but 6-pin.

PG-4C As above, but 8-pin, as supplied with MC-60A.

PG-4D Extra 4-pin cable for MC-85.

PG-4E As above, but 6-pin.

PG-4F As above, but 8-pin.

HS-7 Micro-headphones.

KPS-7A 13.8 V DC, 7.5 A intermittent DC power supply.

RA-3 2 m, 3/8 λ telescoping antenna with BNC connector.

RA-5 2 m 1/4 λ /70 cm 5/8 λ telescoping antenna with BNC connector.

RA-8B 2 m StubbyDuk® with BNC connector.

RA-9B As above, for 220 MHz.

RA-10B As above, for 440 MHz.

RD-20 Dummy load, 50 Ω DC-500 MHz 20 W continuous, 50 W intermittent.

PG-3A DC line filter for mobile use.

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NEVER SAY DIE

from page 4

electronic ham senility wall, you're probably wondering whether you should cheer or holler bloody murder over the Don Stoner W6TNS proposition that we forever give up the top half of six meters.

Now I have no objection to Don getting rich as Croesus with his new idea. Heck, it might even help a bunch of people get rich—and that's nice too. But there's that niggling question that frankly niggled enough to wake me up at 2 am and get me out of bed to write this. I really hate to be niggled out of bed.

Don's proposal, in case you missed it, calls for us to donate the 52–54 MHz half of six meters for use as a non-ham digital message band. His idea is that there are zillions of computer hobbyists out there who might jump at the opportunity to network over the air instead of by telephone. Moot. I won't go into a long technical explanation of how Don proposes this be done so as to keep TVI to a minimum, so let's just not worry about that part of it. The main question is this: Do we hams need that unused half of six meters for anything anymore?

My first reaction is to admit that no, it sure doesn't look as if we'd be giving up much. But as I think it through I realize there are enough points to consider so I could effectively argue—heatedly, of course—either side of the proposition.

First, on the pro side, I have to admit, as a pro, that the frequencies in question are flat out not being used enough to honestly offer any argument against Stoner. Even more, never in the past have we ever really used or even needed these two MHz for much. To take that one more step—I don't even see any potential use ahead for the frequencies.

To make it even more binding, I remember that we have a dying hobby where we're seeing less and less innovation—even if there was a new technology ahead that might need to use these frequencies, I'm not sure we have enough pioneers to make it happen.

Most of us are so tied up with nightly 75m rag-chewing nets, exacerbating the 20m pileups on minor DX, or telling people at great length where we are in our car over a 2m repeater that the top half of six meters is as remote as our going on a DXpedition to Sarawak.

Hey, that isn't a bad idea—remind me to develop that one for you later.

Okay, if we've never had any use for the band—if we're not using it now—and if we don't even have the faintest hint of any future use for the band, why not shut up and donate it to the cause of making Stoner rich? What was it that got me out of bed to write this morning?

History is what done it. Let's go back and take a look at six meters and its history. One of the benefits of being as old as I am is that I'm a living connection to the past. Most of the time this is more of a bore than a benefit, since few younger people want to hear about "how it was." When I start talking about nickel ice cream cones their eyes glaze over.

The six meter band came to us after WWII—I think we got it along in 1946 or so. Before The War we had a five meter band—54–60 Mc. 50–54 Mc was the FM radio band—mostly used by the Major Armstrong experimental FM station in Alpine NJ. Was it W2XEL? After WWII that ended up as TV channel 1 for a while, with 54–60 Mc as channel 2.

This was sorted out by moving FM to 88–108 MHz and channel 1 being changed to the six meter ham band. I was one of the early explorers on six. I was living in Brooklyn at the time and I was the only ham in New York City on six meters. Unlike the old pre-war five meter band, where what little activity there was was made up of little one-tube modulated oscillators, six meters started right out with crystal-controlled rigs.

I could tell exactly who was on the air in a few seconds just by the frequency of the carrier. I had an accurate frequency standard—surplus General Radio LR-1 job—a 94-tube three-foot high kluge. So when I'd hear a carrier I'd just crank the LR-1 until I'd get a beat note and read the call letters off a frequency chart I'd made.

It might be Frank W2AMJ down in New Jersey or Ed Tilton W1HDQ, the VHF editor of *QST* way up in Connecticut. There were just a few of us, so we all knew each other.

I remember a local Brooklyn SWL coming over on his bicycle to visit. He'd heard me talking on channel 1 of his TV set—yep, some of the early TVs had channel 1 on 'em. Years later he got involved with computers as a hobby and opened a successful computer store in Westchester—advertised in my computer magazines.

You know, come to think of it, this early work on 6m was what got me into publishing. In order to keep track of when 6m was opening for DX contacts a number of us put beacon transmitters on 50.1 MHz. I rigged up a code disk with a microswitch to key my 6m rig and let 'er run when I wasn't making contacts.

Perry Ferrell organized a government-sponsored research project to investigate 6m propagation, so I naturally participated with my beacon. Later, when he became the editor of *CQ*, I kept in touch with him, explaining about my work with digital communications and RTTY. This lead to my writing a column in *CQ*. Then, when I helped Perry get a better job as the first editor of *Popular Electronics*, I fell heir to his old job at *CQ*. . . much to my surprise.

Perry edited Poptronics for years—then, in one of Ziff-Davis's larger publishing miscalculations, he was canned. Perry and his wife, Jeanne Gillespie formed Gilfer Associates and sold SWL equipment and information by mail. Perry died a few years ago and Jeanne is still running the business. Say hello to her at Dayton. Better yet, look over her SWL equipment—you might just want a Sony 2002. I've got one and use it every day for time ticks, shortwave, and FM.

Unlike six meters, two was enormously busy in the late 40s. It was a time of change on two, with a few broad old modulated oscillators and an increasing number of crystal-controlled—stabilized, they were called—rigs. I was one of the first to get on 2m with an SCR-522—*the* first, I think.

I remember, when 2m first opened, having a ball with a pair of 6C4 tubes in a grid-modulated long-line oscillator in the trunk of my '40 Ford. The receiver was a super-regen. W2NYC and I would drive to the highest hill in Brooklyn and work over to Staten Island and New Jersey with it.

The next big event was when a ham, George Sterling W1AE, became the Chairman of the FCC. This was when we got our Novice Class license. Novices were permitted voice communications—145–147 MHz. The League was in the hands of an arrogant, foulmouthed general manager, so the FCC wasn't even talking with them. The ARRL fought the new license class, but were no match for the FCC Chairman. The League has never really accepted Novices as actual hams.

Eventually the FCC discovered that Novices were infinitely more interested in voice than CW communications, with most of 'em migrating quickly to 2m. Unfortunately they then lived out their two-year license on 2m and never made it to General. So they killed the 2m Novice band and brought us the Technician Class license—which the ARRL also fought and has hated ever since. Techs got to use the old Novice 145–147 MHz band—and the six meter band.

Techs took to 6m with a vengeance. Six was hot during the sunspot highs, opening often to Europe and around the country. I worked all over Europe on six meters. When six was hot it would be jammed with stations—almost like CB. Can you imagine tuning from 50.1 on up to above 51.0 MHz and not finding a clear spot to work? There were even a few explorers up in the 51–52 MHz part of the band!

Six stayed a hotbed of Tech activity up until 2m FM and repeaters came along. That got started for real in 1969. By 1973, six was almost deserted. These days you hear an occasional ghost signal on six. Not much doing there. Back in 1972 I cross-banded my 2m repeater to six. That was fun—with occasional contacts out in Ohio, Tennessee or Florida when the band opened.

Six meters never really recovered from the 2m repeater explosion, so it sits there, waiting for some hoped-for technical development that might bring interest to it again. Even the sunspot highs won't do much for it because 6m is mostly an American band. It's used for other services in Europe these days.

Now, to get to a con point. And no remarks about me being a con-man. Up until 2m FM and repeaters came along the top 2 MHz of 2m was almost totally unused. The General Class licensees tended to operate

from 144–144.5 MHz and the Techs from 145–145.3 MHz.

Oh, let me tell a story. Ed Tilton, W1HDQ, got all bent out of shape over some local 2m hams who kept interfering with his DXing on the low end of the band. Ed had a big antenna and plenty of power, so he had a Big Signal. I had a Big Signal from Brooklyn too—with my 16-element beam and a kilowatt. Well, Ed couldn't get a couple of lids to move up the band and let him DX so he got the League to petition the FCC to set aside 100 kHz for CW-only.

Believing that we would do better to reason with lids than to legislate band segments like that, I countered with the proposal to put the CW band at the top end of 2m—147.9 to 148.0. The FCC did just that, to my great delight. Ed had been bragging that he was going to get those damned lids off his frequency. Well, the new CW band got zero use, of course, and eventually it was shifted to the low end, where it's been a royal pain ever since.

Getting back to two meters. There was a strong push by *CQ Magazine* to take the unused 2 MHz—146–148 MHz—and make a CB band out of it. After all, we hams weren't using it and would never need it for anything, so why not? I fought the proposal with *73 Magazine*, and it was defeated. If we'd gone along with the *CQ Magazine* idea that an unused ham band would probably never be needed, we could easily have lost the most used ham band we have today.

So I worry. I see us losing frequencies at every turn. We just lost the low ends of the 420–450 MHz and 1215–1300 MHz bands. No, we're not using these much right now, but I can see some real solid potential for their need—particularly if we ever manage to get amateur radio growing again by getting some youngsters into our hobby.

Will some technical development come along to make us regret donating half of our now dormant six meter band to Stoner's plan? Maybe, maybe not. We can't tell about that any more than we could foresee needing frequencies for repeaters. We sure lucked out on that one.

Now, let's suppose that we do somehow manage to get amateur radio growing—with thousands of ham clubs in schools again the way it used to be before Incentive Licensing wasted them. Let's suppose, even further, that we're able to put together a national digital communications network where any of us will be able to type a message (or speak it into a typer) and have it automatically relayed anywhere in the country. Will we be able to do this without having an unused resource of ham frequencies for this new service?

I can see a network of local digital repeaters—maybe working on the packet principle—tied through satellite links to the entire world. Would we need that 2 MHz of six for this or could we get by with what we have to spare on 2m?

Oh, writing of digital, within a couple years I expect we'll be seeing digital television starting to take over. Our 8mm video tape will go digital, making it possible to relay video any number of times anywhere without even the slightest loss of picture.

Of course there is always the possibility—maybe even probability—that all we will ever need for amateur radio are our old bands where us old timers can hang out and ragchew until we die.

Writing of dying, I've noticed that what used to be a small box in QST—Silent Keys—these days has taken on more the dimensions of a special segment of the magazine. I go through it each month, marking the old timers I've known personally—remembering them. An even better exercise is to join the QCWA and go through their newsletter, which dwells even more on the swelling tide of dear departeds. Probably mostly smokers, eh?

Well, what do YOU think about our giving six meters to Stoner? Of course I'm exaggerating—if Stoner gets his plan accepted we'll see a bunch of firms—Japanese firms, of course—making equipment for the new band. If many people get interested in the new band it could turn into a new industry, complete with a Wayne Green magazine. And think of the potential for selling high powered amplifiers for a one-Watt limited band! Zowie! Shades of CB.

Other than that I like Stoner's idea. I'm not at all convinced the new service would attract many users, but if it did it could be fun.

The millions of home computers do present a challenge. If the people with these could be enticed to network them over the air, it could be a big industry. Surveys have shown these computer owners to be interested in radio communications, but to be so put off over having to learn the Morse Code to get a license as to be unavailable as potential hams.

Any thoughts?

MAKING MONEY

When you think about the enormous shortage of electronic technicians in the United States, you realize that there's lots of opportunities out there for anyone with entrepreneurial leanings to make money. It's so easy for any ham who is really interested to make money that I get a bit annoyed when I hear hams complaining about being short of money. It's out there in gobs.

For instance, maybe 15 years ago I recommended that hams interested in making a few extra bucks could do worse than get into selling alarm systems for homes and commercial buildings. I heard from quite a number of hams who took my editorial seriously and went into the business part time to start, but soon found it far more remunerative than their old job. Many did very well.

Well, that same business is still out there, waiting for anyone with some gumption to get into the business. Today only 8.6% of private homes have alarm systems. You couldn't ask for an easier market!

You can sell and install alarms—all kinds.

Continued on page 91

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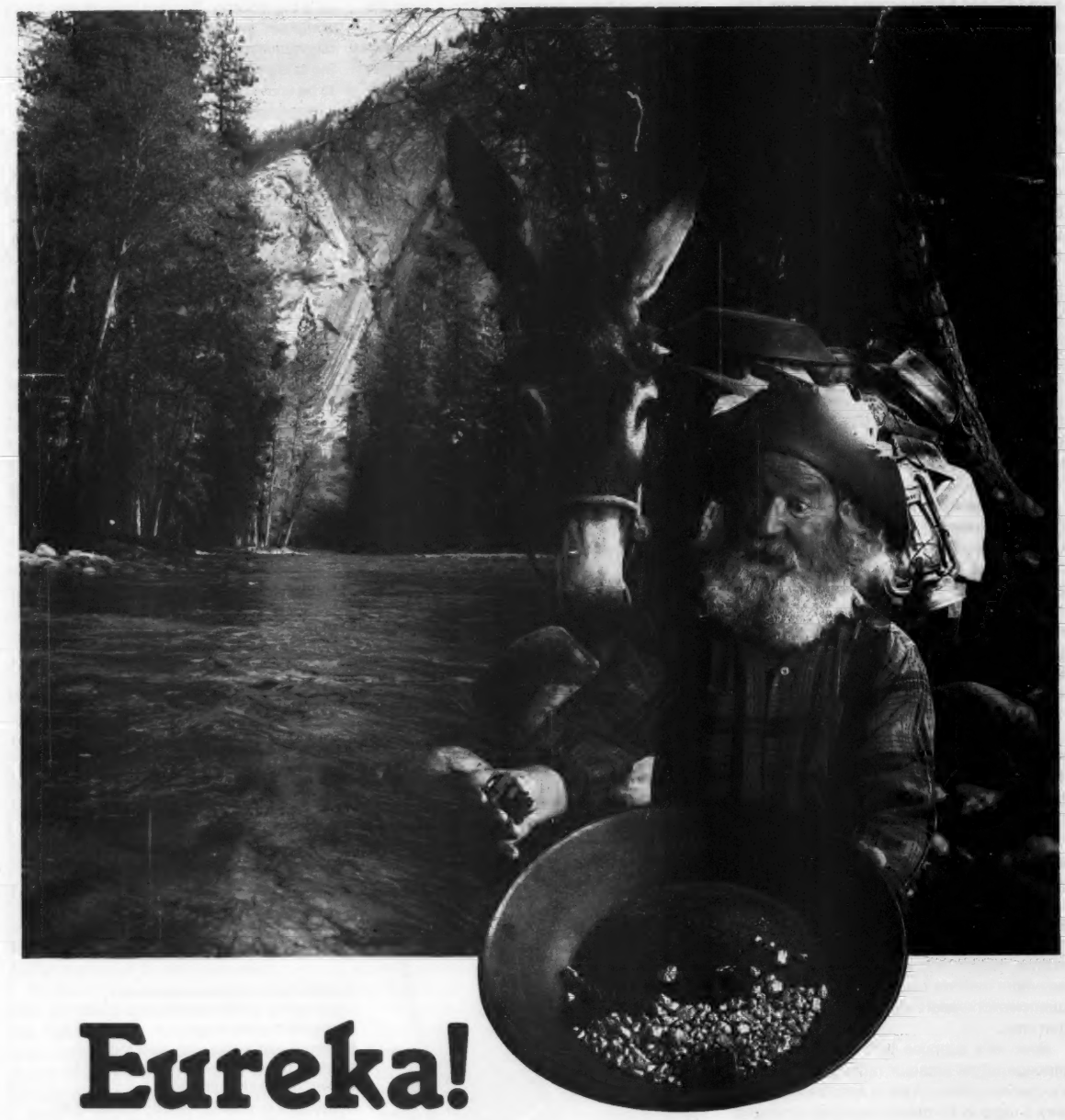

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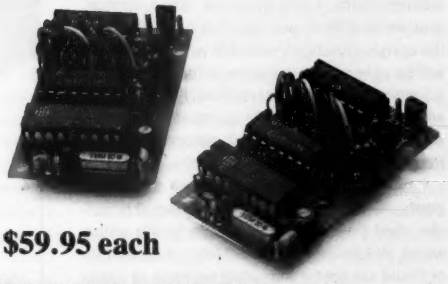

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LETTERS

WELCOME BACK

Congratulations on your return to being a great ham radio magazine. I subscribed to *73* for many years after it started publishing. Finally, it got so oversized that I couldn't find the time to read it. I dropped my subscription because I couldn't stand to wade through about 180 pages to find two or three articles I liked. I picked up the January issue on a newsstand, and I liked it.

Donald Burr AJ6X
Fresno CA

THE NOVICE DEBATE

I have read in past issues the pros and cons of Novice enhancement. Most of those against it are the ones that are afraid that frequencies might be taken away from them. I have yet to see a band that had barriers that kept higher classes from using Novice frequencies.

Come on, let's all grow up and start looking at the plus side of letting Novices use SSB on 10 meters. When was the last time you actually held a QSO on 10 meters, or heard it being used on a regular basis? Many hams would prefer to have the newer bands put in place of the 28-MHz positions on their bandswitch. Many don't even switch to it or listen to it. Of course this wouldn't open the band up because no one would be talking; everyone would be listening. But by allowing the Novice to use SSB on 10 meters, someone would be talking. With the power output allowed to Novices, they could easily talk 20–60 miles daily. This would not be another 11-meter band. I believe we could control ourselves enough to prevent that. Let's stop crying about what might be taken away, and start looking at the plus side:

1. Hams actually using a band (which would normally go unused) and monitoring it on a daily basis.

2. More chances for DX on 10 meters once other countries know we are using the band again.

3. More chances for Novices to get together and hold a conversation that doesn't take two hours to say how the weather is.

4. More Novices would band together and would be able to offer each other the assistance needed to upgrade.

Numbers 1 and 2 are important to all of us, but number 4 is important as well. It is a lot easier to upgrade to higher classes if you have someone to study with. I believe we would actually have an increase in hams upgrading above the Novice/Technician tickets.

John M. Lothridge WD4NQG
Tampa FL

John, you're probably right about the need to get Novices off CW and onto phone again—also the possibility for getting our many unused bands active by opening them to Novices. But I don't think you'll ever get the League to go along with you, and remember, they can get 1% of the clubs to totally swamp the FCC any time they want. Perhaps the FCC is easily swamped. With ten dead these days, Novices might bring it back to life. And then there's poor old six meters, even deader than ten. Two is pretty occupied, except on the low end—how about a Novice phone band from 144.–144.1? I think we've got a lot of room for Novices on 220 MHz. 432 is busy, at least in Los Angeles. 1250 is wide open—as are all the rest of the bands above that. But John, on #4, you're dreaming. Once Novices get phone privileges you'll never see them make the slightest attempt at going for a higher grade license. That's what we found when they were on 2m and there's no reason to believe you'll see it any different if we try it again.—Wayne.

FIND THE GOVERNOR

This is no doubt one of a great many letters you will receive from Texans correctly identifying Texas Governor Mark White as the man on the left and K5RC as the one in the middle of the "County Bounty" photo in "QRX" (January 1986).

An interesting issue. I enjoyed it.

R.B. Peebler W5KIW
Radio Officer, S.S. *Bay Ridge*

AN UNJUST ACCUSATION

In my four years as an amateur radio operator, I have never heard anything as disgraceful as a recent event on a Long Island NY 2m repeater.

Several stations involved in a round table were interrupted by another station who inserted his call between transmissions. When the breaking station was given the opportunity to speak, a majority of his signal was noise. A control operator then broke in and advised that the interrupting station was not listed in the callbook and was operating illegally.

After repositioning, the station called in again with a full-strength signal. At this point, the control op ordered the station to cease communications at once, saying if the station wished to use the repeater he would have to send a copy of his license for verification purposes. Later, the control op announced he had in fact overlooked the callsign in the book and apologized to the station.

Another station came on to criticize the control op for the manner in which he had handled the situation. The control op informed him he obviously did not have any idea how to operate a repeater. This know-it-all control op was responsible for emissions from the repeater and should have activated some function to prevent the outside station from getting into the machine. Besides, he also violated the rules by directing his transmission to a so-called unlicensed party.

Do you think a new ham would be very impressed with the hobby after having an experience like this? What about the ham who has been licensed 25 years and suddenly changes his callsign? Would that ham now be illegal since he is not yet listed in the book?

Hopefully the control op will use better practices in the future. I'm sure any ham would be just a bit more than angry if he or she was called an illegal operator!

Jeff Gornstein NJ2Q
Springfield NJ

Jeff, it sounds like your control op has a sure cure for a non-jammed repeater. But if that's the worst you've heard, you need to hear some tapes of L.A. repeaters. Hmmm, maybe there's a market for garbage like that—I may be missing an income source.—Wayne.

HELPFUL READERS

Needing a circuit for a Hallicrafter S40A receiver, I wrote to *73*'s "Ham Help" asking for same. I obtained a copy shortly after this request appeared.

I was both surprised and pleased in getting several more copies from other readers. Although I tried to reply to all, writing is difficult for me as I am badly vision-impaired.

It is gratifying to know that the spirit of cooperation and help from one ham to another is still as strong as it ever was. And through the good offices of *73* Magazine others may similarly be helped.

I wish to thank all those who have helped and offered to help me with this project.

Gerald Samkofsky N4ZB
Holiday FL

Gerald, all 73 readers are true-blue, we just won't settle for any other kind.—Wayne.

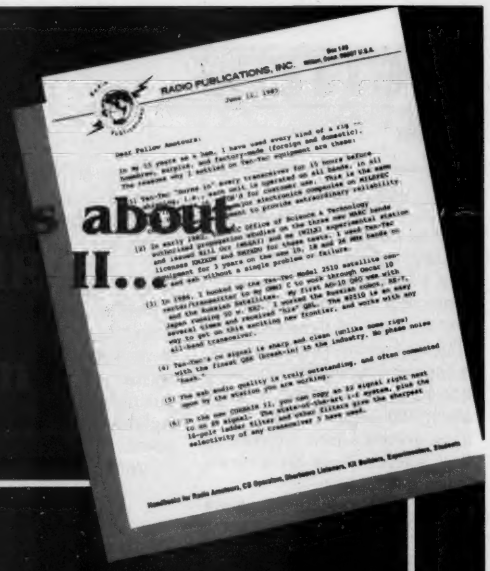
TURNING OFF TEENS?

In his letter in the January, 1986, issue, Mr. Vrenios came very close to the true cause of the increasing average age of amateurs. As he noticed, this is not a problem unique to amateur radio. The fact is, today's youth are less interested in model trains, stamp and coin collecting, photography and all hobby activities.

Why? Many of today's teens are spending their free time with microcomputers and video games, popular music, and the endless channels of cable TV. Most of these youths will not discover hobbies until they reach college where clubs and organizations promote various interests, or until they mature a little and begin to consider computers as something you use at work, lose their interest in pop music, and grow bored with TV. As a result, the average age of almost all traditional hobby groups is shifting up a little.

While the shifting age of operators is nothing to worry about, declining membership is a real problem. The solution is not changes in the rules, but simple public relations. I won't oppose a no-code license if it will do what its proponents say, but I don't think it will. My experience has been that once a person gets excited about amateur radio, the code is a very low hurdle to step over.

The real problem we have in at-



We wanted to know what STUFF COWAN thinks about TEN-TEC'S NEW CORSAIR II...so we asked him

In my 53 years as a ham, I have used every kind of rig — homebrew, surplus, and factory-made (foreign and domestic). The reasons why I settled on Ten-Tec equipment are these:

Ten-Tec "burns in" every transceiver for 15 hours before shipping, i.e., each unit is operated on all bands, in all modes before it is OK'd for customer use. This is the same type of test used by major electronics companies on MILSPEC components and equipment to provide extraordinary reliability.

The ssb audio quality is truly outstanding, and often commented upon by the station you are working. Ten-Tec's cw signal is sharp and clean (unlike some rigs) with the finest QSK (break-in) in the industry. No phase noise "hash."

In the new CORSAIR II, YOU CAN COPY AN S3 signal right next to an S9 signal. The state-of-art i-f system, plus the 16-pole ladder filter and other filters give the sharpest selectivity of any transceiver I have ever used.

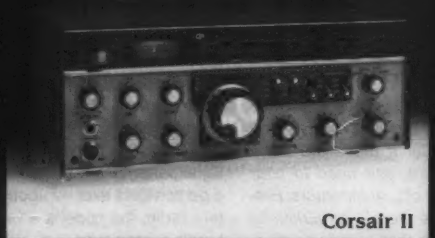
You can listen to two signals, on different frequencies, at the same time with the optional second VFO for the new CORSAIR — a big advantage for DXers.

Ten-Tec gives you the best service in the industry — just ask any Ten-Tec owner. Turn-around time is usually ten days to two weeks compared to a month or more with other manufacturers. Ten-Tec gives service tips on the phone and offers free replacement modules for 12 months.

"I have never owned more reliable, satisfactory equipment than that designed and built by Ten-Tec in the United States."

-Stuart D. Cowan, W2LX

*Stuart D. Cowan is recognized as one of the world's foremost authorities in ham radio. He is an author of Handbooks for Radio Amateurs, CB Operators, Shortwave Listeners, Kit Builders, Experimenters, and Students. He and Bill Orr (W6SAI) worked together in propagation studies on the new 10, 18, and 24MHz bands as authorized by the FCC. Experiments also included satellite communication. In the experiments he used Ten-Tec equipment for three years on cw and ssb "without a single problem or failure."



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tracting new members is the uninteresting image of amateur radio today. Too many people view the hobby as a bunch of old men gossiping with each other. This problem has been frustrated by the advent of cheap shortwave receivers and scanners, bought by people hoping to hear stations from all over the world. Unfortunately, these radios and the antennas people use are so poor that they generally end up with only Radio Moscow, BBC, VOA, WWV and the ham down the street. When they do get stations from faraway places, they quickly discover that people in Norway really do speak Norwegian.

So they tune to the amateur bands and gain first-hand experience with what amateur radio is all about, or so it seems to them: endless, purposeless rag-chewing; traffic nets with no traffic; rude contest operators; "contacts" that consist of nothing more than name, location, signal report, and "Send me your QSL card, I need it for my worked-all-states award."

Scanner listeners, meanwhile, are finding that paging has gone digital, that radio telephone has moved to 800 MHz (above the coverage of many scanners), that it's hard to follow a conversation through a trunked repeater system and that a $50 "descrambler" from the local radio shop will not crack Motorola DVP. So they too turn to the ham bands. Here they either find one repeater that's so busy the operators have to fight each other, or 50 repeaters each occupied by one operator with, by strange coincidence, the same call sign as the repeater.

Next time you're on the air, especially you VHF and UHF repeater users, think about this: What kind of image are you presenting to the non-amateurs who are listening?

The real solution to this problem is for local clubs to become more active. I know, in the past, local clubs have tried to maintain a low profile to avoid being blamed for every speck of snow on every TV in the area, but it's time to come out of the closet and make your organizations visible. Let's show the public what amateur radio is really all about: public service, emergency communications, technical development and, of course, a lot of good fun.

Chuck Gollnick KA7QEN/0
Ames IA

Chuck, I've been hamming for 47 years now and you've described 95% of what I've been hearing for 47 years—endless, purposeless ragchewing, rude operators, pileups, contest-type contacts, and thousands of repeaters with but one operator using 'em. What we have to do is convince kids that endless, purposeless ragchewing and contest-type contacts are by golly real fun. If we promise 'em anything else we're lying. I'd have to lump our public service, emergency operating, technical development and interesting ragchew contacts in the 5% bracket if I were going to be honest.—Wayne.

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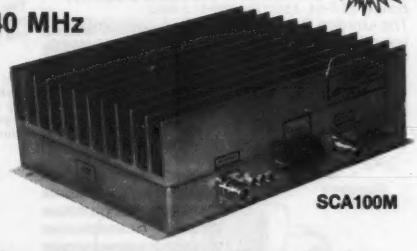
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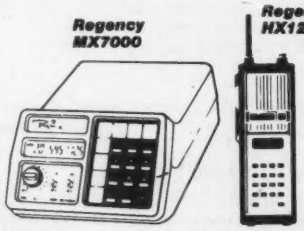

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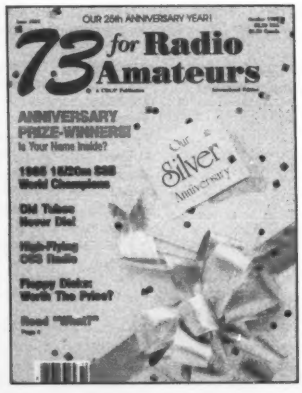

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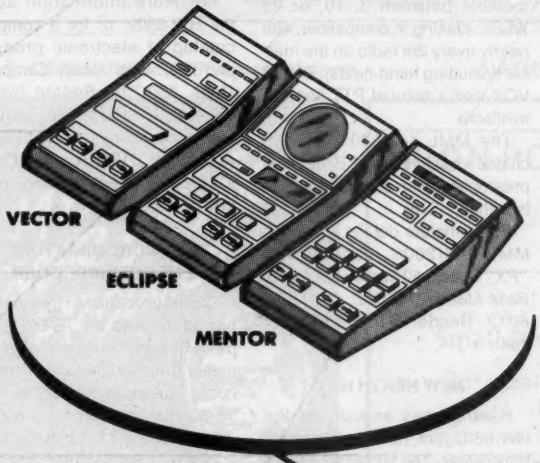

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***PARAGON* A NEW PRECEDENT IN ANTENNA TECHNOLOGY**

NEW PRODUCTS

HAPN INTROS PC PACKET ADAPTER

The Hamilton and Area Packet Network has introduced a plug-in terminal node controller (TNC) for the IBM PC and compatibles. The card includes the TNC, a Bell 202-style 1200-baud modem, and a pre-drilled prototyping area.

Bare boards are available for $75, and an assembled/tested unit costs $199; contact *HAPN at Box 4466, Station D, Hamilton, Ontario, Canada L8V 4S7.* Reader Service number 150.

REGENCY HX1200 SCANNER

Regency Electronics now offers the HX1200 hand-held scanner. The HX1200 covers eight bands: 30–50 MHz, 118–136 MHz, 144–148 MHz, 148–174 MHz, 406–420 MHz, 440–450 MHz, and 470–512 MHz. Frequencies may be stored in any of 45 keyboard-programmable channels.

The Regency HX1200 is priced at $369.95 and comes with a wall charger, carrying case, belt clip, flexible antenna, earphone, and nickle-cadmium batteries. For complete details, contact *Regency Electronics, Inc., 7707 Records St., Indianapolis IN 46226.* Reader Service number 151.

Regency's HX1200 VHF/UHF Scanner.

ESP UPS

Electronic Specialists is now marketing an uninterruptable power supply. The UPS is capable of supplying power for up to 20 minutes, and outputs a clean sine wave. The internal batteries are automatically kept at full charge.

Two models are available for power requirements of 250 or 500 Watts. Options include power line phase-lock, blackout illumination, and provision for an external battery.

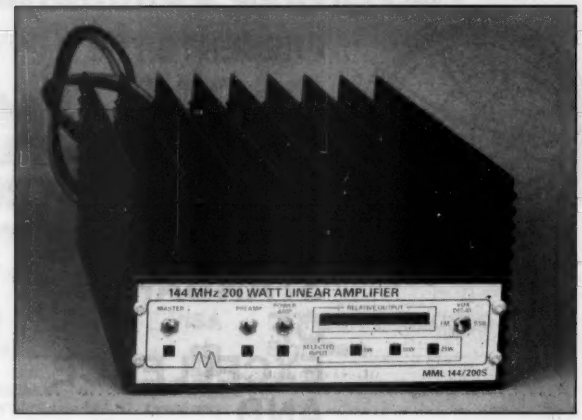
For further information, contact *Electronic Specialists, Inc., 171 South Main St., Natick MA 01760; (800)-225-4876.* Reader Service number 152.

ACC SOFTWARE UPDATE

Advanced Computer Controls has released new software for its RC-850 Repeater Controller.

Version 3.4 supports multiple telephone lines (including up to three lines linked by radio), expands autodial storage to 250 telephone numbers, adds slots for 35-digit dialing sequences, and offers several modes of paging, such as five-tone sequential, DTMF, CTCSS, and HSC. Analog measurements performed by the controller have been enhanced to include stored low and high values on each channel, tagged with the time and the date. The controller also keeps track of internal functions such as number of key-ups or autopatches.

For information about the RC-850 Repeater Controller, or to find out how to upgrade your RC-850 to Version 3.4, write or call *Advanced Computer Controls, Inc., 10816 Northridge Square, Cupertino CA 95014; (408)-749-8330.* Reader Service number 153.



Microvave Modules' MML 144/200S.

SELECTABLE-INPUT 2M AMP

Microwave Modules of Liverpool, England, has announced the Model MML 144/200S 200-Watt linear amplifier for 144 MHz. The input power level is switch-selectable between 3, 10, or 25 Watts, making it compatible with nearly every 2m radio on the market (including hand-helds). Both rf VOX and a manual PTT line are available.

The MML 144/200S also includes a built-in GaAsFET receive preamplifier with a noise figure of less than 1.5 dB.

For complete details about the MML 144/200S, contact *The "PX" Shack, 52 Stonewyck Drive, Belle Mead NJ 08502; (201)-874-6013.* Reader Service number 154.

NEW HEATH HT

Heathkit has announced the HW-6502 2m hand-held/mobile transceiver. The HW-6502 covers 144–145.995 MHz and has a receive sensitivity of .25 uV.

A mobile console, the HW-6502-2, is available that houses the transceiver and is able to boost the transceiver's output to 25 Watts with an optional amplifier. The console provides power and switching and features a lighted frequency display.

For more information about the HW-6502, or for a complete catalog of electronic products and kits, write *Heath Company, Dept. 150-735, Benton Harbor MI 49022.* In Canada, contact *Heath Company, 1020 Islington Ave., Dept. 3100, Toronto, Ontario M8Z 5Z3.* Reader Service number 155.

CSI MICROMINIATURE ENCODER/DECODER

Communications Specialists has announced the TS-32HB Super-Microminiature Programmable Encoder/Decoder. The encoder comes in two styles: The TS-32HBH measures 1.5"x.65"x .65", while the TS-32HBL is 1.5"x 1.2"x.4". Both units are de-

The RC-850 Repeater Controller from ACC.

signed to fit within the confines of miniature hand-held radios.

Programming of the 32 available EIA tones is via a board-mounted DIP switch. Input sensitivity is rated at 6 mV rms and the decode bandwidth is ±1.5 Hz. The adjustable output measures up to 6 V across a 10k resistance.

The TS-32HB is available for $64.95; for further information, contact *Communications Specialists, Inc., 426 West Taft Ave., Orange CA 92665-4296; (800)-854-0547.* Reader Service number 156.

A.P.E. DESOLDERING PUMPS

Automated Production Equipment has announced five new hand-held desoldering tools, each designed to address a specific problem in component removal. The DP-1 features all-metal construction and an anti-static tip. Model DP-2 combines an anti-static body with a conductive tip. Models DP-3 and DP-4 are all-plastic; the DP-3 has extra capacity and the DP-4 incorporates a spring-actuated return mechanism. The DP-5 is spring-actuated, conductive, anti-static, and comes with an anti-static tip.

For more information, contact *Automated Production Equipment, 142 Peconic Ave., Medford NY 11763.* Reader Service number 157.

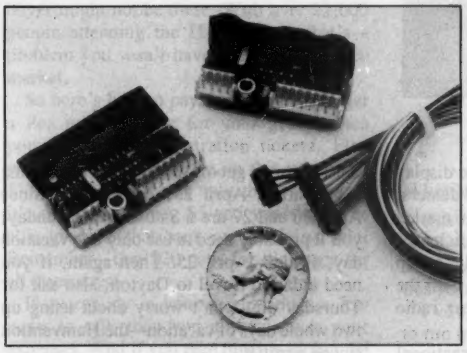
The Kantronics Packet Communicator II.

KANTRONICS KPC-2

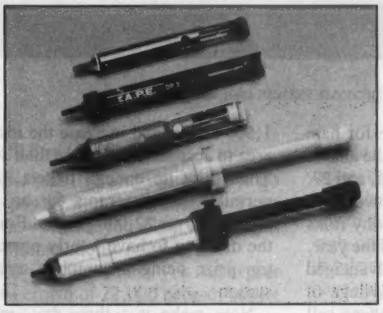
A new terminal node controller, the KPC-2, is now available from Kantronics. The TNC features multiple connects (up to 26 at a time), a built-in HF modem, RS-232C or TTL operation, and AX.25 version 2 protocol.

If you are having trouble easing into packet technology, consider *Basic Packet*, a video tape designed to teach the fundamentals.

For more information about the KPC-2, or about *Basic Packet*, contact *Kantronics, Inc., 1202 East 23rd St., Lawrence KS 66046; (913)-842-7745.* Reader Service number 158.



CSI's TS-32HB CTCSS encoder/decoder.



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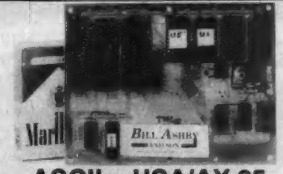

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The Dayton Hamvention '86

The Center of the Ham Radio Universe

It's almost that time again—time for ham radio's biggest bash of the year, the annual Dayton Hamvention on April 25, 26, and 27.

If you've been to any of the Hamventions over the past 34 years, you know why folks tend to get excited about this time of the year. But if you are one of the few, disadvantaged people who has never had the privilege of spending three days at what some fans call "the center of the ham radio universe," then you've got some learnin' to do.

I'm sure most of you have been to a hamfest and have enjoyed yourself. It's great to check out some of the old and new gear and have a chance to meet some of the old and new hams. And most events feature drawings where you have a chance to win a piece of gear donated by a local dealer. In short, hamfests are a lot of fun.

Now take your local hamfest and enlarge it. Spread out the flea market to cover over 1,500 spaces and increase the inside display area to accommodate more than 200 dealers. Then print up enough tickets, flea market permits, and programs for an anticipated crowd of over 22,000 people. Finally, set up the drawing to have hourly prizes, with the top prize being a complete amateur radio station.

Now make it a three-day, international event and instead of expecting hams from all parts of your home county, expect guests from all over the world. If you can successfully relate those changes to your local hamfest, then you have a good idea of what the hamvention is like. Of course, the best way to know what a Hamvention really is like, is to experience it for yourself!

Planning Your Trip

The first thing you need to do—assuming you're a member of the working class, like most of us—is get off work for the days of the Hamvention, April 25, 26, and 27. Since April 26 and 27 are a Saturday and Sunday, you'll probably need to use only one vacation day, Friday, April 25. Then again, if you need a day to travel to Dayton, also ask for Thursday off. Don't worry about using up two whole days of vacation—the Hamvention is well worth it.

Next, get together with your local hams and find out how many are interested in making the trip. You'll probably find a few who have been before and some others who have wanted to attend but have been waiting to go with a group. Tell them the dates they'll need to be off work, and that they'll probably need about $100 to cover the expense of the trip.

How did I come up with that figure? From experience I can tell you that $100 will just about pay for one person's tickets, share of the food, travel expenses, and motel accommodations. That amount will vary, of course, depending on how far you have to travel, what method of travel you use, where you stay in Dayton and what restaurants you pick, but overall that $100 figure is a pretty good starting place in estimating basic costs. Each year, we travel by car about 500 miles from West Memphis, Arkansas, to Dayton, Ohio, and when we end up splitting the expenses, that's about how much it comes to for each of us. So if you live farther from Dayton, add $25 or $50 to be on the safe side.

Here's a money-saving tip: If you plan early, order your room reservations through Hamvention Housing, 1980 Kettering Tower, Dayton, OH 45401-1930. Most area hotels and motels work with Hamvention Housing and offer a special rate for guests during the Hamvention. Although no reservations are taken by telephone, you can get more information about room rates and locations by calling Hamvention Housing at (513) 223-2612.

Covering Expenses

Now that I've told you how much it should

Photo A. SRO inside the main exhibition hall. Recognize anyone?

cost you to attend the Hamvention, wouldn't it be nice if I had a magic formula you could use to pay for the trip? Hold on to your rubber duckies fellow hams, I'm just about to pass that along.

One of the biggest attractions of the Hamvention is its 1,500-space flea market. It's large enough to cover about two city blocks and it usually contains at least one of every amateur radio doo-dad ever marketed. If you want it, you can find it at Dayton. And if you can't find it at Dayton, you'll probably never find it!

Now, if you'll look around your shack or garage, I'm sure you'll find a few items that you've been meaning to take to the local hamfest and sell. The local hamfest attracts a limited crowd, however, and that certain buyer might not be there. With over 22,000 people attending the Hamvention, that's a problem you won't have at the Dayton flea market.

So here's how to pay for your trip. Order a flea market space for your group when you order your registration tickets. Flea market spaces have gone up this year from $17 to $20, but if you split that four ways, it's only costing you $5 and you should be able to make that back on your first sale. Remember—that $20 pays for the space for all three days!

If everybody in your group brings a few items to sell, then you all can cover your expenses. And if you take turns manning the booth, then everybody gets a chance to make a raid on the flea market. Also, it's a BIG flea market, and few people have the stamina to cover the entire area in one trip. Your flea market space gives you a place to rest. Finally, your space becomes a location for the members of your group to congregate. For all of these reasons, the flea market space is a bargain, and if you work it right, should pay for itself and help you pay your trip expenses.

If you're sold on getting the flea market space, keep these simple rules in mind: Spaces are sold in advance only, and your registration tickets should be ordered at the same time.

Send requests for flea market spaces ($20 each, limit four) and tickets ($8 each) to Dayton Hamvention, PO Box 2205, Dayton OH 45401. In the left-hand corner write FOR FLEA MARKET REGISTRATION.

No bikes, motorized skateboards, or roller skates will be allowed in the flea market. If you plan to use a gas heater or stove, please protect yourself and others and have a fire extinguisher available.

Persons holding flea market permits and registration tickets can enter the flea market beginning at 8 a.m., Thursday, April 24 to set up their numbered, assigned space.

If you have any other questions about the flea market, you can call the special Flea-Market Hotline at (513) 223-0923. You'll be getting your information firsthand since you'll probably be talking to Flea Market Chairman John Grody or his lovely wife, Cathy, but keep in mind this phone is in their home—so try and call before 10 p.m. EST.

Photo B. The flea market stretches on and on.

What You'll See

Okay, now that I've told you where to go and how to pay for it, maybe I could give you a little preview of what you might be seeing at this year's Hamvention.

I've already mentioned that you can expect to run into a crowd of 22,000 people, but let me add that the Hamvention organizers have planned to accommodate such a large group. I've never had to stand in a line longer than one or two people to buy a drink or a sandwich, and if you'll try to eat prior to the noon hour, you should be able to avoid the lunch crowd.

"No bikes, motorized skateboards, or roller skates will be allowed in the flea market."

One other time you might stand in line is to take advantage of an incredibly low price on some of the newest, most popular amateur gear. If you are looking for the best price on that certain piece of equipment you've been dreaming about, you'll probably find it at Dayton.

For example, I found a package of 10 floppy disks to range in price from a high of $12.95 to a low of $7.95. The $7.95 offering was a good quality disk, so guess which one I bought? These quickly sold out but later on, I noticed the $12.95 price had been cut to $10.95 and eventually this dealer also sold out.

This brings up an important point—how low can the prices get and when should you buy? No one owns a crystal ball, but I usually pick a price beforehand that I am willing to pay and if I can get it for that price then I'm happy. In some other cases, when to buy depends on what the item is. If it's a handi-talkie, there's always a great demand at Dayton. They usually sell out fast, so find the lowest price and buy immediately. If it's a high-priced item like a deluxe low-band rig, the demand should be less and you should have more time to shop.

One important buying rule at Dayton: Prices are usually at rock bottom on Sunday when the dealers are packing up, so buy then, or buy on Friday and Saturday but ask the dealer for his Sunday price.

One shopping tip—you might want to jot down on a piece of paper some of the items you definitely want to purchase while you're at the Hamvention. After all, there are three large inside areas for the more than 200 exhibitors in addition to the flea market, and with so much to look at you could forget what you intended to purchase.

One thing I can guarantee you'll see at Dayton is the newest in amateur radio gear. Manufacturers like to display their state-of-the-art gear to the largest crowd possible, and that obviously means unveiling it at Dayton. They might not have gone into production yet on what they show so you might not be able to buy it, but you will definitely be able to see the prototype and get an idea of what the future of amateur radio is going to be.

Dayton also offers the unique opportunity to talk directly with the person who designed a particular piece of equipment. These days you might need to know how to speak Japanese to do so, but in many cases I have found the inventor also manning the booth and available to answer every question you can think of about his electronic brainchild.

The Weather

I have to hand it to the Hamvention organizers! For the last two years they've been able to arrange for absolutely perfect weather. But just because there were clear skies and moderate temperatures for the last two years is no guarantee it will happen again for the

Photo C. Only one more day to go!

1986 Hamvention. In fact, the best way to handle the Dayton weather is to plan for the worst, which could mean freezing temperatures and constant downpours.

Keep this changeable weather possibility in mind as you pack your weekend bag, and let practicality rule. Jeans will be standard, but be smart and toss in long underwear just in case the weather makes a chilling change.

On top, start simply with a T-shirt, then add a long-sleeved shirt (you can roll up the sleeves if it gets too warm), a medium-weight jacket and then finish with a waterproof or rain-resistant coat. Now you're ready for the cold and rain—and if the weather is warm, you can take off the coat and jacket as needed.

One last thing. Bring along a heavy coat and keep it handy. That way, if the temperature takes a deep dip you'll be ready.

The Big Day

After all of the planning, your big day at Dayton finally arrives! It's April 24, you're in the Wright Brothers home town, and you're wondering what is the first thing you should do.

Never fear, your guide is here! My suggestion: take a quick run over to Hara Arena and check the place out. Don't know how to get there? Follow these simple directions. Take Interstate 75 to Needmore Road and exit west, turn right on North Main, then turn left on Shiloh Spring Road, and watch for Hara Arena to be on your right.

Next, you should secure your accommodations. Then, depending on the time you have available, you might want to visit the New Air Force Museum at Wright-Patterson Field (just 10 minutes from downtown Dayton) or the Dayton Museum of Natural History, 2629 Ridge Ave. (home of the Dayton Amateur Radio Association Club station, W8BI).

On Friday, it's a good idea to get an early start, but keep in mind that the Hamvention does not open until noon. That gives you plenty of time to eat breakfast, drive to Hara Arena and get your flea market space ready for customers.

Once the Hamvention begins, persons holding tickets are allowed to wander freely inside and out but are required to show their tickets whenever they enter the indoor exhibits. The first time you go inside, enter through the front doors of the Silver Arena and you'll receive your copy of the official Hamvention program.

Find a seat in the arena stands and take a minute to look over the program and the schedule of activities. You'll see the times and locations for all of the planned forums. These times are definite, and if you wish to attend a particular forum plan your shopping sprees around it.

On Saturday, the flea market opens at 6 a.m., while the inside exhibits open at 8 a.m. Both close at 5 p.m., much earlier than Friday night's closing time of 8 p.m. This is to allow those who are attending the Hamvention banquet time to change and drive downtown to the Dayton Convention Center.

Tickets for the banquet are available for $14 in advance or $16 at the door (if available then), and if you've never attended, maybe you should include this event in your Hamvention plans. Each year at the banquet, awards are given for Radio Amateur of the Year and for special achievements in amateur radio. There is always an interesting featured speaker. Add to that a great meal, and you know why many amateurs consider the banquet the high point of the weekend.

The flea market opens at 6 a.m. again on Sunday and inside exhibits at 8 a.m., but buying and selling activity starts to slow down as the time for the prize drawings nears. Yes, prizes are awarded all during the Hamvention weekend, but for those unclaimed prizes, another drawing is begun at 2 p.m., and is then followed by the drawing for the major prizes at 3 p.m.

Last year, the top prize was a complete ICOM station, so if you feel lucky you might want to stick around on Sunday afternoon!

Additional Activities

There's not enough space here to write about all of the activities that are planned in conjunction with the Hamvention; I have hit only the highlights. There are also alternative activities (formerly women's activities), FCC license examinations, YL forums, CW proficiency awards, and forums on almost any aspect of amateur radio.

The Hamvention also furnishes a shuttle-bus service to carry you to and from all participating hotels and motels, Hara Arena, the Air Force Museum, and to the Dayton Convention Center for the Saturday night banquet.

So this year plan to be a part of the Dayton Hamvention. Get a group together and follow the steps listed below for a very enjoyable weekend at "The Center of the Ham Radio Universe," April 25-27. My guess is that you'll have a fantastic time and find yourself doing what we do on the trip back home—planning for next year's excursion to the Dayton Hamvention!

General Information

- Hamvention Information—(513) 443-7720.
- Flea Market Hotline—(513) 223-0923.
- Housing Information—(513) 223-2612.
- Flea Market Setup Day—April 24. Registration tickets and flea-market permits must be shown together for admission to the flea market prior.
- Prices—Registration Tickets $8 in advance, $10 at door; flea market spaces $20; banquet tickets $14 in advance, $16 at door (if available). ■

CHECKLIST

- ☑ Get the group together to see who wants to go, then figure on how many cars you'll need to make the trip.
- ☑ Talk to the boss and arrange to have April 25 off (and April 24 if you need a travel day).
- ☑ Secure room reservations for the nights of April 25 and 26, and if you plan on arriving Thursday, include the night of April 24 in your reservations.
- ☑ Order your registration tickets and flea market permits early and at the same time.
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Your Bridge Over Troubled Antenna Tuning

Is your antenna less than ideal? Put more fire in the wire.

The popularity of resonant antennas fed by "flat" coax lines has led to the development of bridges of various types to aid in antenna tuning, line selection, and the design and adjustment of stubs and impedance-matching networks. The proper adjustment of an antenna system requires that a signal be radiated for considerable lengths of time. If you use an appreciable amount of power, this signal may create needless and annoying interference.

The bridge I'll describe here supplies only 2.5 milliwatts to the feedline; it regains sensitivity by employing a dc amplifier between the rectifier and the meter. The internal crystal oscillator will operate at any frequency from 160 through 10 meters on either fundamental or overtone modes. It is crystal-controlled because antenna systems are frequency-sensitive; quartz is the simplest and probably the least expensive way to insure stability. The entire unit, including batteries, is housed in a cabinet so that it can be moved to "where the action is."

The Bridge

A resistance bridge is simpler than an impedance bridge. It shows its deepest null in the absence of reactance. Reactance at the antenna end of a line is never desirable. Hence a resistance bridge is adequate for matching antennas to line provided that it is always used with a repeating line (See Note 1). Referring to Fig. 1, the bridge uses a pot for "differential resistance" balancing. This arrangement yields an open scale in the range 0–5 Ohms, characteristic of low antennas and close-spaced arrays, and an increasingly compressed scale extending to over 1,000 Ohms. In this way, a large range is achieved by a low-resistance pot. It's important to minimize bridge resistances to reduce errors, particularly at high frequencies. It also is important to minimize the capacitance of the pot to ground; this is done by mounting it off ground and using an insulating shaft coupling. The usual precautions of minimizing lead lengths, orthogonal mounting of parts, shielding, and so on, are observed.

The Oscillator

For accuracy, this type of bridge requires a closely sinusoidal exciting voltage. Clean waveforms are easily produced only with tuned-circuit oscillators. A link winding is a simple way to match the oscillator to the low bridge resistance. The Pierce circuit will operate with crystals of highly variable activity. The "Tuned Pierce" circuit will excite the fundamental or odd overtone modes of most crystals, regardless of their labeling—hence the choice of this circuit.

Two ranges are switch-selected: 1.75–7 MHz, and 7–30 MHz. The large ranges are made possible by maximizing the ratio of maximum to minimum capacitance shunting the coils. This is done by the use of a large variable capacitor having a large inherent-capacitance ratio, coils with low distributed capacitance, and care in reducing strays, such as mounting the switch and crystal socket off ground and minimizing lead lengths. The gate is biased by the dc-restorer action of the diode. No source resistor is used because the large g_m at zero bias encourages oscillation to start. Transistor dissipation is within rating at zero bias.

The Dc Amplifier

I selected a dual J-FET op amp because it has high input impedance, low offset voltage, low input current, and internal-drift compensation. The first stage uses the non-inverting circuit so

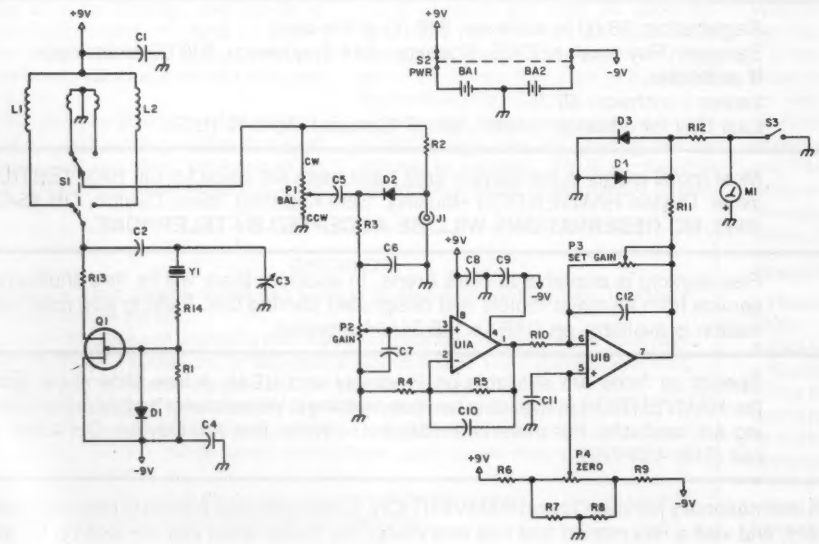

Fig. 1.

that the gain pot may operate into a virtually open circuit, ensuring that the gain of the entire amplifier varies upwards linearly from zero. The gain from pin 3 to pin 1 is fixed at 11. Large capacitors are used throughout the circuit to reduce the gain for all frequencies except dc; limiting the bandwidth suppresses the oscillator signal and reduces noise.

". . . the sensitivity is adjustable over a very large range . . ."

The second stage uses the inverting circuit with gain adjustable from zero to 10 by means of a variable feedback resistor. The zero pot supplies a small variable bias of either polarity to a virtually open circuit. This bias neutralizes the offset voltages of both amplifier stages. It also is useful for setting the meter upscale so that the null is more easily observed.

The meter is protected at about twice full scale by the back-to-back silicon diodes, which are in turn protected by the 1k resistor. The amplifier is internally protected. The meter shorting switch is used to eliminate transient deflections caused by battery switching.

Calibration

Although a theoretical calibration is easily derived, it is not accurate because the pot is not exactly linear. Accurate calibration is made by connecting resistors of known value to the rf connector, balancing the bridge, and marking the scale accordingly. The half-Watt carbon resistors are soldered inside PL 259 connectors and, when cool, bridge-measured at dc. An ohmmeter may be used if the lower accuracy is tolerable.

Substitutions

Use the specified coils; otherwise it may not be possible to achieve the wide tuning range. Some careful pruning may be required anyway because of variations in wiring and parts placement.

Under no circumstances substitute for the balance pot. The Ohmite AB pot is the best affordable component available. It has low inductance and capacitance, and it's quiet.

Bridge Operation

UHF parasitic oscillations indicate their presence by tunable meter indications not controlled by the crystal. They were suppressed in this case by R13 and R14. Crystal modes are easily identified because the tuning is asymmetric and abrupt. It's best to check the oscillator on a receiver to be sure it is crystal-controlled and starts dependably. This adjustment may then be forgotten until the frequency is changed.

The null position is set by turning the gain pot to zero and moving the meter pointer a few divisions upscale by means of the zero pot. This setting will be stable for a long time. The operation of the bridge is like that of any other bridge except that the sensitivity is adjustable over a very large range—in fact, the maximum usable sensitivity is set by brush noise in the balance pot.

Antenna Tuning

Since the subject is complicated, I'll limit discussion to the procedure for the horizontal half-wave coax-fed dipole with a 1:1 balun. The best that you can do here is to resonate the antenna and measure its feedpoint resistance. You can then make a decision on a method of feeding it.

The antenna is connected to the bridge by means of a repeating line that is long enough to reach from the final position of the antenna to the ground. (See Notes 1 and 2.) This brings the bridge, in effect, to the feedpoint, but the operator and the gear are safely on the ground where, because they are well removed from the radiating wire, they do not distort the field. Starting with the antenna symmetrical and too long, consecutively null the bridge and make small symmetrical changes in antenna length until the deepest null is obtained (See Note 3). Here the antenna is resonant, the reactance is zero, and the bridge reads the feedpoint resistance.

In the unlikely event that this resistance matches a standard coax, the appropriate line may be connected and run any length into the shack. In any other case there will be standing waves on the line and it matters how long the line is. Even though the feedpoint impedance is a pure resistance, the input impedance of the line will have reactance unless it is either a repeating or an inverting line. (Notes 4 and 5.)

The inverting line may be useful in two cases. When the feedpoint impedance is 33.3 Ohms, a 50-Ohm inverting line will make the input impedance 75 Ohms. And when the feedpoint impedance is 112.5 Ohms, a 75-Ohm inverting line will make the input impedance 50 Ohms. I have used the first arrangement with a very low dipole. The second may not be practical, since theory asserts that the maximum feedpoint resistance is less than 100 Ohms.

Probably the best solution is to install a repeating line having Z_o closest to the feedpoint resistance so that the swr will be minimized. If the transmitter will not load properly, the line-input impedance may be transformed to 50 Ohms resistive by means of a pi section filter or other simple matching network.

Discussion

All antennas are less than ideal due to economic and physical restrictions, but a given antenna will work better if it has more current in it. It will have more current in it for a given transmitter dc input power if it is resonant

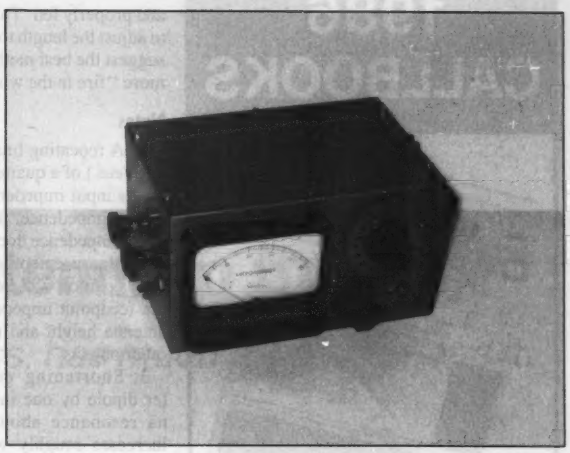

Photo A. Side panel. Back to front: P3, P4, S3.

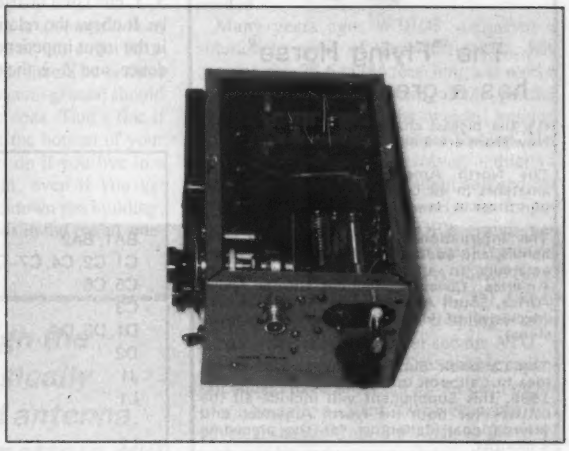

Photo B. Inside. Rear, dc amp, front left, P1, center, L2, L1, right Q1 strip. Panel, upper row, J1, S1, Y1, lower right, C3. Batteries left of C3.

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and properly fed. This bridge will enable you to adjust the length to resonance, and will also suggest the best method of feed. Use it to get more "fire in the wire."

Notes

1. A repeating line is an even multiple (2, 4, 6, etc.) of a quarter-wave long, electrically. Its input impedence is equal to its terminating impedence. For this application, its surge impedence does not matter.

2. Measurements made in other than this final position will be of little value because the feedpoint impedence varies widely with antenna height and position with respect to other objects.

3. Shortening each end of a 40-meter dipole by one inch will raise the antenna resonance about 18 kHz. The effect increases roughly with the square of frequency, i.e. $\Delta f(kHz) = f(MHz)^2/2.72$ approximately.

4. An inverting line is an odd multiple (1, 3, 5, etc.) of a quarter-wave long, electrically. It obeys the relation $Z_i = Z_o^2/Z_T$ where Z_i is the input impedence, Z_o is the surge impedence, and Z_T is the terminating impedence.

5. Terman (*Radio Engineers' Handbook*, 1st edition, McGraw Hill, 1968, page 186). Eq. (62) may be written $y + A \cos \theta + j B \sin \theta / B \cos \theta + j A \sin \theta$, where $y = Z_i/Z_o$, $A = Z_T$, $B = Z_o$, and θ = angular length of the line. (Or see any text transmission lines.)

Multiplying the numerator and denominator by the conjugate of the denominator will result in the denominator becoming a pure real number. For this proof we find the cases where the resulting numerator is a pure real number. It is $g = (A \cos \theta + j B \sin \theta)(B \cos \theta - j A \sin \theta) = AB (\cos^2 \theta + \sin^2 \theta) + j (B^2 - A^2) \sin \theta \cos \theta = AB + J\ 1/2\ (B^2 - A^2) \sin 2\theta$.

We exclude the case where $A = B$ because we are considering only lines mis-terminated in a pure resistance. G will be a pure real number only when $\sin 2\theta = 0$, which occurs only when $\theta = n\ (90°)$, where n is any integer. Since 90 degrees is an electrical quarter wave, the input impedence will be a pure resistance only for line lengths an integer number of quarter waves long, electrically. This means that either a repeating or an inverting line must be used to avoid reactance in the line output impedence. ■

Parts List

BA1, BA2	9-volt transistor battery
C1, C2, C4, C7–C12	0.05-µF, 50-volt disc ceramic
C5, C6	0.1-µF, 50-volt disc ceramic
C3	730-pF air variable (dual 365 pF with sections paralleled)
D1, D3, D4	1N914 silicon switching diode
D2	1N34A germanium point contact diode
J1	SO-239 rf connector
L1	64T #24 tinned wire 1/2" i.d. 2" long B&W Air Dux #432-T (entire coil) link 6T hookup wire. Substitution not advised.
L2	12T #18 tinned wire 1/2" i.d. 1 1/2" long B&W Air Dux #408-T (remove 4T) link 3T hookup wire. Substitution not advised.
M1	50-µA meter, 1.9k internal resistance
P1	100-Ohm pot, linear taper, Ohmite Type AB Style CMU 1011. *Do not substitute*. Mount off ground.
P2	50k linear taper pot, Ohmite Type AB
P3	100k linear taper pot, Ohmite Type AB
P4	10k linear taper pot, Ohmite Type AB
Q1	N-channel FET (Radio Shack #276-2035)
Resistors all ½-Watt carbon composition	
R1	220k
R2	50 Ohm (select from 47-Ohm stock)
R3	8.2k
R4, R10	10k
R5	100k
R6, R9	47k
R7, R8	680 Ohm
R11	1k
R12	4.7k
R13, R14	22-Ohm UHF parasitic suppressors *required*
S1	DPDT toggle (mount off ground)
S2	DPST toggle
S3	SPST toggle
U1	Dual BiFET op amp Type LF 353 N (Radio Shack #276-1715)
Y1	Ceramic crystal socket for HC6/U; Crystals (mount off ground)
Cabinet	5 x 6 x 9 Bud AU 1040, CU 1099, etc.

Charles Bryant, GW3SB/G3SB
2 Penrhyn, Saint Michael's Road
Minehead, Somerset TA24 5JP
England

Stretch the GP Antenna to the Max

This, the simplest of all antennas, has much to recommend it.

If you've worked a number of Eastern European stations, you've probably been told by some of them that they were using a GP (general purpose) antenna. As their signal is often adequate despite quite modest power, you may well ask what is the secret.

A GP antenna is just a length of wire, usually as long and as high as circumstances permit. Such a wire will have a particular impedance at a particular frequency. Provided that this impedance (which will normally vary from band to band) can be matched by means of a suitable ATU to the output impedance of the transmitter (usually 50 Ohms), it will radiate. It will often radiate well because there are no feeder losses, and moving from one end of the band to the other presents no problem if the ATU is retuned. Although the GP is basically a multiband antenna, its radiation pattern will vary on different bands.

There are a few disadvantages. One end of the antenna is in the shack, which may be dangerous because of high rf voltage. There is also a greatly increased likelihood of causing RFI in the building. At low power, however, these disadvantages are minimal and they can often be overcome even at higher power.

The classical ATU is shown in Fig 1. If the antenna impedance is low, the antenna tap is moved down the coil until proper loading is obtained. Because this presents difficulties when the antenna is nearly an odd number of quarter waves in length, it then becomes necessary to use series tuning.

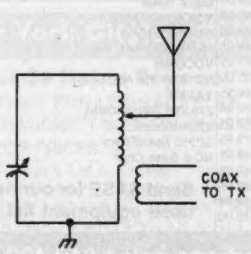

Fig 1. The classical antenna tuning unit.

You'll notice that there is a connection to ground from the bottom of the coil. Textbooks usually state that this should be as short as possible, and that the actual ground should consist of several copper rods. That's fine if your shack is in a hut at the bottom of your garden, but what do you do if you live in a 20th-floor apartment and, even if you get permission to run a wire down the building, can't bury the copper rods in the paved sidewalk?

> ***"Although the GP is basically a multiband antenna, its radiation pattern will vary on different bands."***

In recent years, this problem seems to have been side-stepped by using one of the newer forms of ATU. The Collins Universal Coupler (or π coupler) was around before World War II; since then there has been a spate of ATU designs, each claiming to be better than the last. Many of these designs avoid the link coupling shown in Fig 1. The ground connection is provided through the outer braid of the coax from the transmitter, and is usually connected to the common grounding system of the house wiring.

In most cases, this will work splendidly. I have had contacts with all continents using a π coupler and a length of wire thrown out of a bedroom window. However, as mentioned earlier, rf can appear elsewhere in the building. When other equipment is connected to the common grounding system, serious RFI might result, and standing waves on the grounding wires could cause high rf voltages in the common grounding wire! Except at low power, care is needed.

Many years ago, W3EDP suggested a solution to many of these difficulties. His antenna was 25.6 m (84 feet) long and used a short counterpoise in place of the ground connection. These lengths avoided tapping down the coil to obtain proper loading. His original ATU circuit involved inductive coupling between the PA output coil and the ATU coil. This arrangement is no longer practical. Recently, W3EDP's circuit has been rediscovered in Europe (see "Technical Topics" by Pat Hawker G3VA, *Radio Communication*, January, 1985, p. 35) and is proving quite popular. Link coupling is now used between the transmitter and the ATU.

Fig. 2 gives the circuit. The variable capacitor should have about 1.5 pF for each meter of wavelength; a 150 or 200 pF capacitor will cover all bands from 3.5 MHz to 28 MHz with suitable inductances. Details of the coils and counterpoises for each band are contained in Table 1. It is helpful to have a tuning indicator as the tuning is quite sharp; a 500 uA meter and any small rf diode will suffice.

Wires from the meter are fixed near the ends of the tuned circuit to give slight capacitive coupling and the variable resistor adjusted to give a reasonable reading on the meter. Note that this reading will vary from band to band and is to be used only for tuning purposes. Because it does not indicate power level, the comparison of readings between different bands is quite meaningless.

Formerly, plug-in coils were common and would have been used for L1/L2. These are still around, but if you can't find any, wind the coils on a suitable bit of insulating material and glue this to an old tube base (if possible, use a UX4 as it has bigger pins than an octal one). This procedure may seem old hat, but it avoids the difficulties of using switches for the coils.

The W3EDP version of the GP obviates many of the difficulties associated with the use of a ground connection. There is still need for care to avoid burns from the antenna and, as there is no dc connection to ground, the antenna could be dangerous during a thunder-

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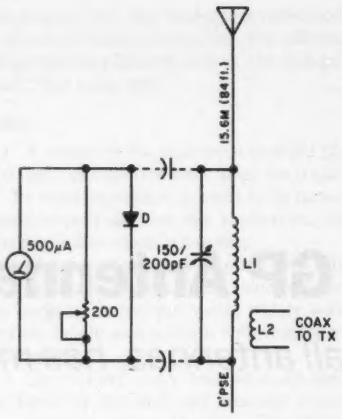

Fig 2. W3EDP antenna and ATU. D is any small rf diode. L1 and L2 are wound on a 3.8 cm (1½ inch) diameter former. For number of turns and details of counterpoise, see Table 1.

Band MHZ	L1 (turns)	L	Counterpoise
3.5	21	4	5.2 M (17 ft.)
7	7	2	5.2 M (17 ft.)
10	4	1	2 M (6.5 ft)
14	4	1	2 M (6.5 ft)
18	4	1	1 M (3.3 ft)
21	4	1	1 M (3.3 ft)
24	4	1	–
28	4	1	–

Table 1.

storm when very high voltages might develop. Otherwise, the W3EDP antenna is particularly useful in locations where the erection of more conventional antennas proves difficult. RFI can often be prevented by changing the direction of the counterpoise.

The GP antenna need not be a straight piece of wire. There is a story—I can't vouch for its truth—that during World War II a clandestine operator in occupied Europe regularly sent out traffic using his bedspring for an antenna! In circumstances when it is not desirable to advertise one's presence, the GP antenna may often be disguised to look like something else. It may even be made of very fine wire, which is invisible from ground level (especially if the glint of the copper wire is removed by passing it through a candle flame). It can be folded or wrapped around an insulated tube such as a piece of plastic piping.

For portable or mobile use, a GP antenna has much to recommend it. Instead of feeding a whip by means of a coax, make a direct connection to the ATU and you have a portable/mobile antenna that can be made to resonate any part of any band. With a little care the GP, which is surely the simplest of all antennas, still has many uses. ■

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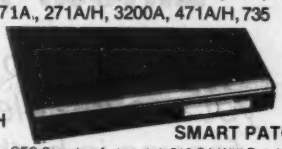

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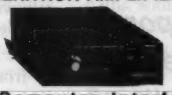

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The Care and Feeding of a Curved Linear Array Antenna System

For low cost, very low maintenance, yet acceptable performance, try this antenna system for use in high-frequency amateur radio operations.

This article documents the performance characteristics of a 39-element curved linear array (CLA) antenna. The system is fully tunable for all amateur bands, costs less than many other antennas (in fact, many hams already have one, if they only realized it), and presents several unique advantages, which we shall discuss later.

Design Considerations

The primary motive in designing this antenna system was aesthetic acceptability. Not necessarily mine, I hasten to add. To put it more clearly, I wanted to be able to do amateur radio without getting thrown out of the mobile home park I'm currently living in.

One highly desirable solution had, unfortunately, been eliminated by the removal of a large pine tree a couple of years before. Said conifer would have provided excellent camouflage for a multiband vertical.

An indoor longwire was tried briefly, but had a disturbing tendency of creating large amounts of rf inside a metal box (the mobile home). This solution was, therefore, quickly discarded.

Being newly upgraded and eager to get on the low bands after five years on VHF, I was desperate for an answer. Considerable discussion ensued among my ham friends about the project, much of it speculative at best. Given that I had a massive amount of aluminum at my immediate disposal, several friends suggested that I load up the mobile home itself. I quickly realized, though, that none of them had offered to be inside the house when this was attempted.

Photo A. The Curved Linear Array antenna, shown installed at the QTH of N6BIS.

". . . a rabbit living in a metal cage on the porch showed no ill effects from my DXing."

Finally, I threw the problem over to Bob Tarone WA6ZBX, who was willing to find the right solution for the situation. Hence his creation of the CLA, or "awntenna."

Specifications

The system we finally implemented is, essentially, a fat longwire. It consists of a 9 by 40-foot sheet of corrugated aluminum—in the common vernacular, a porch awning (see Photo A).

The term "39-element curved linear array" is a straightforward description of the antenna: there are 39 ridges in the aluminum sheet, each of them is curved (arched), and they are arrayed linearly with respect to each other. (There are also five smaller pieces of aluminum holding the thing up, but we try to ignore them.)

The awntenna is fed by a length of four-conductor copper wire (courtesy of Pacific Telephone) from an MFJ 901 tuner and a Heath 104A HF transceiver. (See Photo B.) Maximum PEP output from the Heath is 100 Watts; I have no particular desire to feed more rf than that into the awning.

The height above average terrain (HAAT) is about 9-1/2 feet. It is slightly higher on the side nearest the house, slightly lower away from it, creating a slope of approximately 5 degrees. The lengthwise dimension of the system is oriented almost precisely east-west.

The antenna is not in electrical contact with the house, so far as we can tell. A few short screws attach it to the wood paneling on the side of the house; evidently, they do not go through to metal. Two L-brackets which had secured the awning to the rain gutter were removed during original implementation of the system.

The five uprights are not electrically isolated from the antenna, but are insulated (via mylar booties and plastic bolts) from the cement into which they are bolted.

The awning also does not come in contact with the porch below it. This was proven conclusively in early tests, when a rabbit liv-

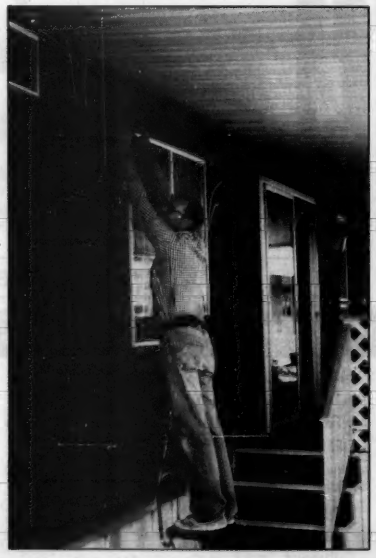


Photo B. Bob Tarone WA6ZBX hooks up the feed line for the awntenna.

ing in a metal cage on the porch showed no ill effects from my DXing.

The antenna is grounded with a short length of four-conductor wire (again courtesy of Pacific Telephone) to a three-foot ground rod driven into adobe earth. A 65-foot dual counterpoise (full-wave at 20 meters) was tried briefly, but discontinued when I discovered that keying up on 15 meters triggered the fluorescent lights in my slide-viewing table.

Total costs for the system were approximately $3(for the ground rod). I already had the antenna tuner and the feedline. Of course, I also already had the awning, saving me some $400 to $500 right there.

Performance

The CLA antenna has been successfully used on all standard amateur bands from 10 to 80 meters, and tunes quickly to 1:1 (or nearly so) on all of them. It does show a certain sensitivity on some bands, but on others it is nearly flat across the entire spectrum.

Due to this impressive performance, I only need one antenna, and therefore never have to worry about whether the correct antenna is in the circuit. I have been known to nab DX stations while friends were still switching antennas.

The predicted and measured radiation patterns for the system are shown in Fig. 1a and 1b. The pattern turned out to be a sort of casual cardioid, with a definite dip towards the north-northwest. This dip is probably caused by the signal going directly through the mobile home, although we're not certain.

As mentioned, the system points almost precisely east-west, but radiation measurements show no particular preference in these directions (or, for that matter, in any others). However, as of this writing, I have used it at 100W to work all 50 states and nearly as many countries. Signal reports tend to be only fair (typically 5/5–5/7), but, after all, DXCC certificates don't come with special endorsements for being 20 over 9.

Unfortunately, the system does lack pointability. Orienting it to a certain direction would involve rotating the entire house, which would subsequently result in major problems—especially with the neighbors. On the other hand, I never have to worry about which way my antenna is pointed, since I have no choice in the matter. I can concentrate on calling while others are still fussing over great-circle maps.

Polarization, direction of current, and phase relationships in different parts of the system have not been measured. Neither, unfortunately, has gain, since I have been unable to move the antenna to a proper testing facility for precise analysis. However our guesstimates put the gain somewhere between −3 and 0 dB.

Additional Benefits

The CLA antenna requires no maintenance, aside from occasionally sweeping the leaves out of it. In fact, no adjustments are *possible*, a boon to those of us who like to just hook up the equipment and go—although admittedly frustrating to those who feel obliged to tinker with their amateur radio gear.

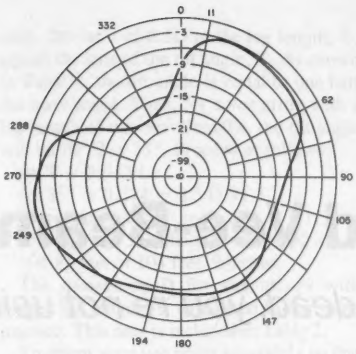


Fig. 1a. The predicted radiation pattern for the CLA.

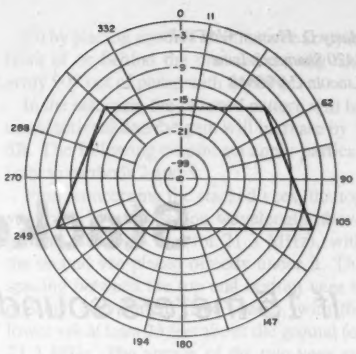


Fig. 1b. The actual radiation pattern for the CLA.

Since there are no moving parts, there's really nothing that can fail. I never have to worry about my rotor dying with the antenna pointed south just as JY1 comes on the air. (Of course, I probably won't even *hear* him anyway, so I won't suffer by knowing what I'm missing.)

The system has the additional advantage of providing shade on hot days—a benefit that hams with much more expensive (and supposedly better) multi-element beams certainly cannot claim.

Backup system

In case my primary antenna should ever fail (i.e., fall down), a backup system is kept nearby (see Photo C). This system is a verted vee, a variation on the more common inverted vee. Informally, this type of antenna is known as "rabbit ears."

One problem with the verted vee is the exceedingly high capacitance between the elements; it's evident that the phrase "dumb bunny" was not created haphazardly. On the other hand, the high density dielectric results in a high amount of capacity loading, thus accounting for its ability to resonate even on 75 meters despite its apparently short element lengths.

Unfortunately, the verted vee system is more appropriate for mobile operation. It is, in fact, *overly* mobile, and keeping it connected to the radio presents considerable difficulties. Luckily, I have never had to use it.

Possible Improvements

Although the CLA system has been working very satisfactorily, several uninvited suggestions have been made for improving it.

The most obvious is to hook together all the mobile home awnings I possibly can, to provide an effectively larger antenna. With some 800 homes in this park alone, and three similar parks nearby, the prospects are truly awesome (or awful, as the case may be). Better yet, of course, would be a system that allowed connection of different houses at will to create the optimum pattern for reaching each target station.

Currently, the antenna is corner-fed. There has been some speculation on whether center feeding would favorably affect the radiation pattern. Since there is very little literature on feeding awnings (other than that they like a little roughage occasionally), any expert comments on this would be welcomed.

Summary

We have considered the design and performance characteristics of a 39-element curved linear array (CLA) antenna system for use in high-frequency amateur radio operations. We have found that this system offers low cost, very low maintenance, and yet acceptable performance.

Exact technical specifications, costs, and installation instructions for this antenna are not available from the author, but may be obtained from Sears Roebuck and similar vendors.

My gratitude in preparing this article goes to Bob Tarone, WA6ZBX, for the antenna concept and construction; to Kit Blanke, WA6PWW, and Glenn Thomas, WB6W, for their assistance in performing the radiation pattern measurements; to Stephen Greenberg, for coining the term "curved linear array;" and to all of the above for contributing valuable jargon with which to properly obfuscate the subject. ■

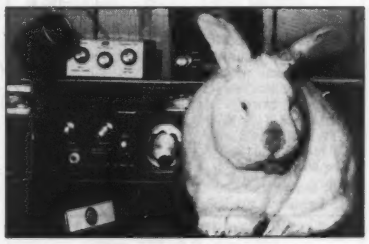


Photo C. The verted vee ("rabbit ears") backup antenna system for the N6BIS station.

Harry D. Hooton W6TYH
1420 Shamrock Lane
Lincoln CA 95648

Stacked Vee-Beam Arrays

If 15 meters sounds dead, you're not using the right antenna!

I am constantly surprised at the number of retired people who have moved to the warmer climates, particularly in the Caribbean area, who use amateur radio to keep in touch with relatives and friends back in the old home town. Most of these people, relative newcomers to ham radio, are not technically sophisticated in the art of antenna design, are limited in income, and depend on inefficient vertical radiators to maintain daily communication.

Many of these hams have sufficient space in which to install a low-cost wire antenna that will give greatly improved performance on both transmitting and receiving. The vee beam for 15 meters, believe it or not, does not require a site in the Sahara Desert to be effective. Besides, a vee system that will double or quadruple your effective radiated power can be built for less than the price of a dinner for two in a good restaurant. Interested? Read on.

Basic Vee Beam Array

The vee beam antenna, originally called the RCA Model D array, is one of the oldest directional antenna systems still in use on the shortwave bands. It was designed originally for commercial overseas radiotelephone service long before the advent of the yagi and other compact arrays. While a vee beam for 40 or 20 meters requires a large area to obtain a high degree of gain and directivity, a similar array for 15 or 10 meters isn't excessively large. For the higher frequency bands, a vee will provide worthwhile gain and directivity even when the legs are as short as two wavelengths, and you can still get some gain when the legs are as short as one wavelength long. The main disadvantage of the short vee, besides having less gain, is that it can't be used with good results on more than one amateur band.

For a frequency of 21.3 MHz, the length of a one-wavelength leg is 45 feet, 4 inches. Two wires in the vee arrangement will produce a bidirectional gain of about 2.1 dB over that of a horizontal half-wave dipole operated under the same power and height conditions. In this case, the apex angle should be 90° for best results. For legs two wavelengths long, the gain rises to about 5.5 dB, and the apex angle is reduced to 70°. For legs three wavelengths long or longer, refer to Table 1.

SPECIFICATIONS FOR 21.3 MHz

WAVELENGTHS	LEG LENGTH (FEET)	APEX ANGLE (DEGREES)	DIMENSION D (FEET)
1	45.04	90	63.7
2	91.24	70	104.67
3	137.44	58	133.26
4	183.63	50	155.21
5	229.83	45	175.90
6	276.03	40	188.81
7	322.23	38	209.67
8	368.42	35	221.60
9	414.61	34	242.44
10	460.81	32	254.033

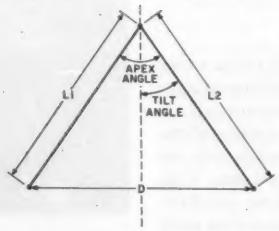


Table 1. Important dimensions of vee beam antennas.

In the absence of tabulated data, the apex angle can be made equal to twice the lobe angle of a single wire of the same length. To roughly determine the gain of the vee beam, compared with a longwire of the same number of wavelengths, add 6 dB to the gain of a single leg operated alone when the leg length exceeds two wavelengths. Thus, a longwire antenna five wavelengths long will have a gain of about 4 dB in each of its major lobes. If two such longwires are used in the vee configuration, you add another 6 dB and the bidirectional gain rises to 10 dB. A gain of 10 dB represents an effective transmitter power increase of 10 times. Thus, the 100 Watts rf output power from your Japanese transceiver is effectively raised to 1000 Watts. The estimated vee antenna power gains listed in Table 2 are conservative.

"Steerable" Vee Beam Design

The greatest advantage of the yagi antenna over a large wire array, such as the rhombic, curtain, or vee beam, is, of course, its compactness and the fact that it can be rotated over 360°. The fixed array is most useful for working into a given area, such as Europe or Australia, and is ideal for the retired or disabled ham who works the same station day after day. The two lobes of a vee beam having legs several wavelengths long are comparatively narrow, and the line of the apex bisector must be oriented accurately with respect to the distant station.

Antenna Lengths (Wavelengths)	Power Gain (dB)
1	2.10
2	5.50
3	7.00
4	8.00
5	8.75
6	9.50
7	10.25
8	10.75
9	11.25
10	11.70
11	12.00
12	12.25

Table 2. Estimated power gain of vee antennas with leg lengths of 1 to 12.

The array I'll describe here is designed so that the direction of the apex bisector may be shifted in azimuth by about 15° to 20°. This arrangement allows the center of the lobe (apex bisector) to be laid "dead on" the distant location. The rope and pulley arrangement also allows the apex angle to be adjusted accurately with a field-strength indicator to obtain optimum gain.

My W6TYH vee beam is suspended from three large oak trees that nature was kind enough to grow as the corners of an equilateral triangle about 120 feet on a side. It was decided to make each leg of the vee two wavelengths long. Referring to Table 1, a leg two wavelengths long is 91 feet, 4 inches, and the apex angle for a vee with two wavelength legs is 70°. The bidirectional gain is about 5.5 dB, about the same as that of a two-element yagi on a high tower.

To determine distance D between the ends of the two legs at the base of the vee (open end), the ratio of 0.5D to the leg length, L, equals the sine of the tilt angle, T. As shown in Table 1, the tilt angle is equal to one half the apex angle. Thus, for a vee array with a leg length of two wavelengths, the tilt angle will be 70°/2 or 35°. Proceed as follows:

sin T = 0.5 D/L

sin 35° = 0.574 = 0.5 D/91.3

Therefore, 0.5D = 0.574 x 91.3 = 52.4062 = 0.5D, then D = 52.4062 x 2 = 104.81 feet or 104 feet, 9 inches.

The dimension D for vee arrays with longer leg lengths is calculated in the same manner. This data is included in Table 2.

To orient your vee beam accurately so that the apex bisector points to the distant spot on the globe, you should lay out a true north/south reference line through the center of your antenna site. Later, in the section covering the adjustments of the array, I'll tell you how to lay out the reference line and use it to orient the antenna.

When I was setting up the W6TYH antenna, I discovered that the apex end of the proposed vee beam and one tree were on a line precisely east and west. To project the apex bisector line (lobe center) directly on Europe and Australia, the apex bisector should be oriented about 15° north of east and south of west, respectively. To do this, I decided to support the open end of the vee from a 1/4-inch nylon rope stretched between the two farthest (base) trees.

Currently, my array is oriented directly on Sydney, Australia, and is pulled up to a height of about 23 feet above the ground. I work into both Europe and the South Pacific with excellent signal strength reports. Later, I hope to add another vee section in a stacked configuration for still greater gain.

Very High-Gain Vee-Beam Design

The gain of a vee beam antenna system may be increased by any one or all of the following:

(1) By making each leg longer in wavelengths;

(2) by stacking two arrays, one above the other; and

(3) by placing another identical vee array in front of or behind the one and driving one array 90° out of phase with the other.

In the last case, the radiated pattern will be unidirectional and the gain will increase by 3 dB. The following comments apply particularly to methods 2 and 3.

First, concerning the stacked vees, the top vee must be at least one wavelength above ground (about 45 feet for 21.3 MHz), with the second vee placed directly under it. The spacing between the top and bottom vees is one half wavelength (free space), with the lower vee at least 23 feet above the ground for 21.3 MHz. The apexes of the two vees are connected to the two ends of a half-wavelength open-wire line made from two No. 14 copper wire conductors spaced about 4 inches on centers. The right leg end of the upper vee conductor must connect to the same open-wire conductor that is connected to the right leg end of the lower vee conductor. In other words, the upper and lower vees are operated in phase with each other.

Date	Minutes (+) or (-)
January	
6	(+) 6
16	(+) 10
February	
6	(+) 14
16	(+) 14
March	
6	(+) 12
16	(+) 9
April	
6	(+) 3
16	(0)
May	
6	(-) 3
16	(-) 4
June	
6	(-) 2
16	(0)
July	
6	(+) 4
16	(+) 6
August	
6	(+) 6
16	(+) 4
September	
6	(-) 1
16	(-) 5
October	
6	(-) 12
16	(-) 14
November	
6	(-) 16
16	(-) 15
December	
6	(-) 9
16	(-) 5

Notes: Step 1—Make longitudinal time correction first (see text); Step 2—From selected date, determine number of minutes seasonal time correction required (see text); Step 3—Add or subtract seasonal time correction (minutes in right-hand column) to or from longitudinal time correction; Step 4—Add total to local legal or official time (EST, CST, MST, or PST).

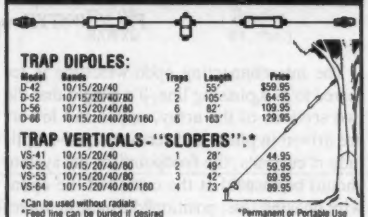
Table 3. Seasonal time-correction chart.

Materials	Cost
250 feet No. 14 plastic-covered electrical wire, copper, at .05 per foot	$12.50
Two 6" insulators; 1.00 each	$2.00
300 feet ¼" nylon rope; .80 per foot	$24.00
Three pulleys for ¼" rope; .90 each	$2.70
3 feet, ¼" copper tubing for L1; .40 per foot	$1.20
C1 from junk box (old BC radio tuning capacitor will be suitable)	
Miscellaneous	$1.00
	$43.40

The above cost is an estimate if everything is purchased. The W6TYH array actually cost less than $25 since some of the material was on hand.

Table 4.

MULTI BAND TRAP ANTENNAS



TRAP DIPOLES:

Model	Bands	Traps	Length	Price
D-42	10/15/20/40	2	55'	$59.95
D-52	10/15/20/40/80	2	105'	64.95
D-56	10/15/20/40/80	6	82'	109.95
D-66	10/15/20/40/80/160	6	163'	129.95

TRAP VERTICALS-"SLOPERS":*

VS-41	10/15/20/40	1	28'	44.95
VS-52	10/15/20/40/80	2	49'	59.95
VS-53	10/15/20/40/80	3	42'	69.95
VS-64	10/15/20/40/80/160	4	73'	89.95

*Can be used without radials
*Feed line can be buried if desired
*Permanent or Portable Use

ALL TRAP ANTENNAS are Ready to use - Factory assembled -Commercial Quality -Handle full power - Comes complete with: Deluxe Traps, Deluxe center connector, 14 ga Stranded CopperWeld ant. wire and End Insulators. Automatic Band Switching - Tuner usually never required - For all Transmitters, Receivers & Transceivers - For all class amateurs - One feedline works all bands - Instructions included - 10 day money back guarantee!

SINGLE BAND DIPOLES (Kit form):

Model	Band	Length	Price
D-15	15	22'	18.95
D-20	20	33'	19.95
D-40	40	66'	22.95
D-80	80/75	130'	25.95
D-160	160	260'	34.95

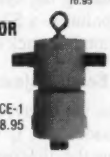
Includes assembly instructions, Deluxe center connector, 14 ga Stranded CopperWeld Antenna wire and End insulators.

COAX CABLE: (includes PL-259 connector on each end)

Type	Length	With antenna purchase	Separately
RG-58	50'	$8.00	$11.95
RG-58	90'	12.00	16.95

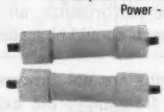
DELUXE CENTER CONNECTOR

★ NO RUST Brass Terminals
★ NO Jumper Wires Used
★ NO Soldering
★ Built-in Lightning Arrestor
★ With SO-239 Receptacle
★ Handles Full Power
★ Completely Sealed, Weatherproof
★ Easy Element Adjustments
★ Commercial Quality



CE-1
$8.95

DELUXE ANTENNA TRAPS: Completely sealed & weatherproof -Solid brass terminals - Handles Full Power - NO jumpers - NO Soldering. Instructions included. For 4-band Dipole Ant. 40/20/15/10 $36.00/pr. For 5-band Dipole Ant. 80/40/20/15/10 $38.00/pr.



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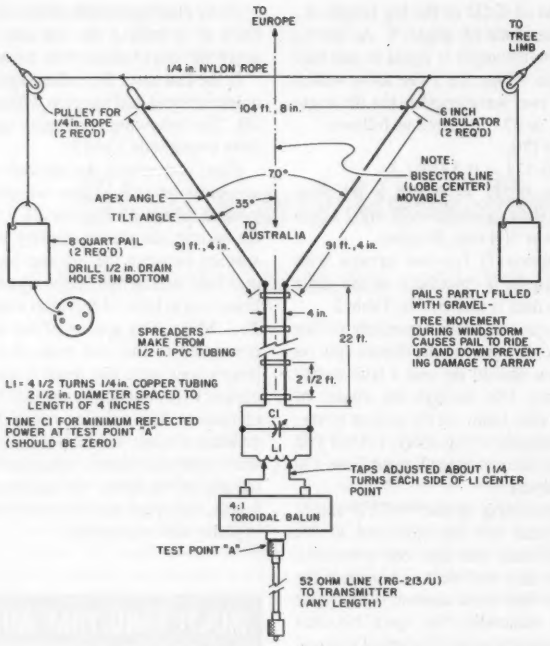

TO EUROPE
TO TREE LIMB
1/4 in. NYLON ROPE
PULLEY FOR 1/4 in. ROPE (2 REQ'D)
104 ft., 8 in.
6 INCH INSULATOR (2 REQ'D)
NOTE: BISECTOR LINE (LOBE CENTER) MOVABLE
70°
APEX ANGLE
35°
TILT ANGLE
TO AUSTRALIA
8 QUART PAIL (2 REQ'D)
91 ft., 4 in.
91 ft., 4 in.
DRILL 1/2 in. DRAIN HOLES IN BOTTOM
PAILS PARTLY FILLED WITH GRAVEL-
TREE MOVEMENT DURING WINDSTORM CAUSES PAIL TO RIDE UP AND DOWN PREVENTING DAMAGE TO ARRAY
4 in.
SPREADERS MAKE FROM 1/2 in. PVC TUBING
22 ft.
2 1/2 ft.
L1 = 4 1/2 TURNS 1/4 in. COPPER TUBING 2 1/2 in. DIAMETER SPACED TO LENGTH OF 4 INCHES
TUNE C1 FOR MINIMUM REFLECTED POWER AT TEST POINT "A" (SHOULD BE ZERO)
C1
L1
TAPS ADJUSTED ABOUT 1 1/4 TURNS EACH SIDE OF L1 CENTER POINT
4:1 TOROIDAL BALUN
TEST POINT "A"
52 OHM LINE (RG-213/U) TO TRANSMITTER (ANY LENGTH)

Fig. 1. W6TYH vee beam for 15 meters.

The interconnecting open-wire line is referred to as a phasing line. To ensure that the two sections of the array, upper and lower, are driven in phase and receive equal-amplitude rf currents, the feedpoint for the system should be located at the center of the open-wire phasing line, positioned a quarter wavelength away from the apex feedpoint of each vee section.

To the center feedpoint of the phasing line, connect another identical open-wire line but only one quarter-wavelength long. This quarter-wavelength line plus the quarter wavelength of line from the apex feedpoint of each vee section down to the phasing line feedpoint will be equal to a distance of one half a wavelength and will cause the open end of the second quarter-wavelength line to appear as a high-impedence point. To feed a high-impedance point on a line, you need a parallel-resonant tuned circuit. Such a circuit is useful for resonating the system and for matching the feedpoint to a 52-Ohm coaxial cable transmission line back to the transmitter.

Vee Beam Adjustments

The vee array, singly, stacked, or excited in quadrature, is virtually foolproof. If you follow the dimensions and instructions given here the array won't fail to perform with good results. For maximum performance, all dimensions and adjustments should be made as accurately as possible.

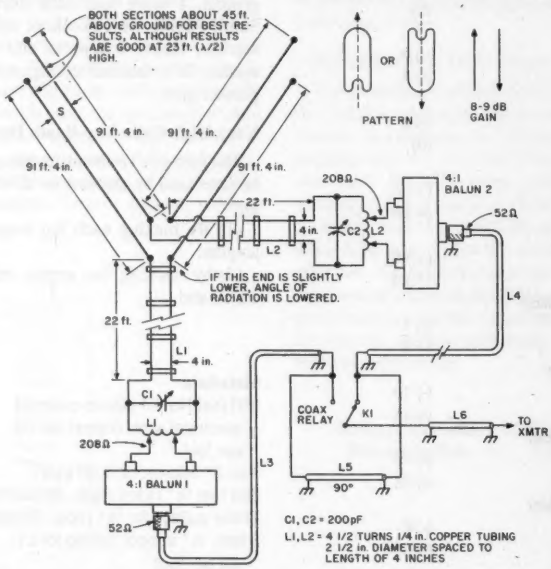
The exact leg lengths are not extremely critical for a given frequency; the exact lengths specified here have been pruned to allow you to use the array over a bandwidth of about 200 kHz without having to retune the coupling circuit at the antenna or change the loading at the transmitter. The longer the leg lengths, the less critical the adjustments with respect to a change in frequency.

Once the array has been installed, connect the two output terminals of the 4:1 impedence ratio toroidal balun transformer at points about one or two turns each side of the L1 center point. Connect an swr (reflected power) meter in series with the 52-Ohm line and the coaxial input terminal of the balun (Test Point A in Fig. 4). Set the meter selector switch on F (forward), and turn the indicator sensitivity control all the way off. From the transmitter, apply an unmodulated carrier signal of about 5 Watts or less, and of the correct frequency, to the 52-Ohm line. Adjust the swr meter sensitivity control until the indicator pointer reads exactly full-scale forward. Now, throw the meter selector switch to indicate reflected power (R). Quickly rotate C1 for the lowest meter indication ("null" or "dip"). If you can't bring the indicator pointer to zero, move the balun tap connections away from or closer to the center of L1.

When the tap connections are correct and the indicator pointer reads zero by adjustment of C1, the 52-Ohm line will be "matched" through the balun to the 208-Ohm balanced feedpoints on L1. At the transmitter, the line should "match" the transmitter 50-Ohm output impedence without having to use an antenna "tuner." The transmitter output circuit should load normally to the rated output power level.

Field Strength Adjustments

To adjust the array for maximum gain (field strength), I used a portable, battery-operated solid-state short-wave receiver. The General Electric Model 7-2990A or equivalent is ideal for this purpose. The GE receiver is equipped with a digital-readout frequency



Notes: (1) S=0.25. L1-L2=openwire line, #14 copper spaced, 4". *L1 must be exactly same length as L2.* (2) L3-L4=RG-213/U or RG-8/U coaxial lines. *May be any length but must be exactly the same length.* (3) L5=RG-213/U or RG-8/U. L=162.36/f where f=frequency and L=feet. For 21.3 MHz, length of RG-8/U or RG-213/U=7 feet, 7½ inches. (4) Unidirectional pattern may be switched in either of two directions along apex bisector line. Gain over dipole approximately 8–9 dB. (5) Adjust taps on L1 and L2 for zero reflected power at test point A. Adjust each section individually as per text and then recheck entire system in operation. Trim minor adjustments of C1 and C2 as required.

Fig. 2. Endfire vee beam for 15 meters.

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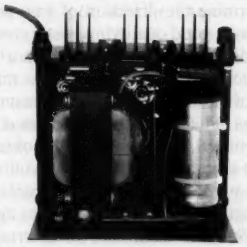

INSIDE VIEW – RS-12A

RS and VS SERIES

SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
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- THREE CONDUCTOR POWER CORD
- ONE YEAR WARRANTY • MADE IN U.S.A.

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- INPUT VOLTAGE: 105 - 125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE: Less than 5mv peak to peak (full load & low line)

MODEL RS-50A

MODEL RS-50M

MODEL VS-50M

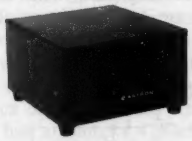
RM-A Series

MODEL RM-35A

19" X 5¼ RACK MOUNT POWER SUPPLIES

Model	Continuous Duty (AMPS)	ICS* (AMPS)	Size (IN) HXWXD	Shipping Wt. (lbs.)
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
• SEPARATE VOLT & AMP METERS				
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50

RS-A SERIES



MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W X D	Shipping Wt (lbs)
RS-4A	3	4	3¾ x 6½ x 9	5
RS-7A	5	7	3¾ x 6½ x 9	9
RS-7B	5	7	4 × 7½ × 10¾	10
RS-10A	7.5	10	4 x 7½ x 10¾	11
RS-12A	9	12	4½ x 8 x 9	13
RS-20A	16	20	5 x 9 x 10½	18
RS-35A	25	35	5 x 11 x 11	27
RS-50A	37	50	6 x 13¾ x 11	46

RS-M SERIES

MODEL RS-35M

• Switchable volt and Amp meter

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
RS-12M	9	12	4½ x 8 x 9	13
RS-20M	16	20	5 x 9 x 10½	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13¾ x 11	46

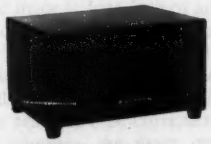
VS-M SERIES

MODEL VS-20M

- Seperate Volt and Amp Meters
- Output Voltage adjustable from 2-15 volts
- Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H x W x D	Shipping Wt (lbs)
VS-20M	16	9	4	20	5 x 9 x 10½	20
VS-35M	25	15	7	35	5 x 11 x 11	29
VS-50M	37	22	10	50	6 x 13¾ x 11	46

RS-S SERIES



MODEL RS-12S

• Built in speaker

MODEL	Continous Duty (Amps)	ICS* Amps	Size (IN) H x W x D	Shipping Wt (lbs)
RS-7S	5	7	4 x 7½ x 10¾	10
RS-10S	7.5	10	4 x 7½ x 10¾	12
RS-10L(For LTR)	7.5	10	4 × 9 × 13	13
RS-12S	9	12	4½ x 8 x 9	13
RS-20S	16	20	5 x 9 x 10½	18

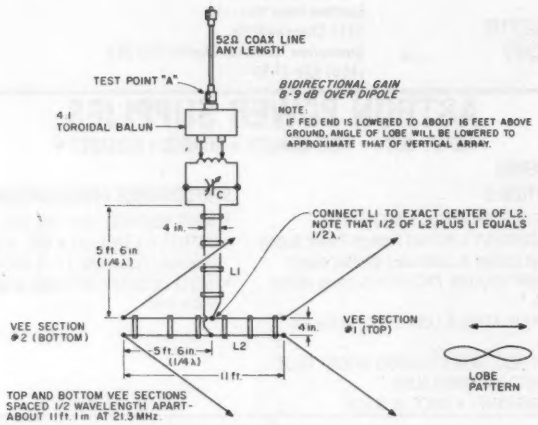


Fig. 3. Stacked vee beam array for 15 meters.

indicator, accurate to about 1 kHz, and a signal-level meter (not a calibrated S meter). In order to adjust the array for maximum field power, I placed the little receiver about a mile away from and directly in front of the antenna, and varied dimension D for maximum signal-level indication. The increase in the field strength was barely perceptible, but it was satisfying to know that the array was in optimum adjustment.

Vee Beam Unidirectional Operation

When two vee arrays are arranged one behind the other, spaced a quarter wavelength apart, and driven 90° out of phase, the pattern will be unidirectional with maximum radiation in the direction of the array with the lagging rf current. The directional characteristics will be "end fire," but the radiated lobe pattern will be much sharper than the pattern obtained from vertical-phased arrays. Although I haven't calculated or measured the pattern from a double-vee phased array, the rear of the pattern, along the apex bisector line, should be highly suppressed with the usual cardioid notch resulting in a high front-to-back ratio. The phasing control circuit shown can be used to reverse the direction of maximum radiation by 180°. The unidirectional gain of the phased vee system will be about 3 dB greater than that of a single bidirectional array. The directional system is controlled remotely by means of relays and miniature toggle switches.

Terminated Vee Antennas

To make a vee array unidirectional, each leg may be terminated at its far end with a non-inductive resistor of about 400 to 800 Ohms. The terminated-vee radiation pattern is practically unidirectional in the direction of the terminated ends. The terminating device should be capable of dissipating one-third of the rated transmitter rf power output. It may be made up by connecting a number of 2-Watt carbon resistors of suitable values for the termination.

In actual practice, the terminating resistor values are adjusted for minimum standing waves on the transmission line. It's usually necessary to try different values and repeat the procedure at different frequencies throughout the amateur band in order to obtain the optimum resistance value. An insulated counterpoise wire may be connected across the open end of the vee to act as a ground for the termination. The terminating resistor is connected from the end of the vee conductor to the ground wire. Do not connect the ground wire directly to the vee leg conductors.

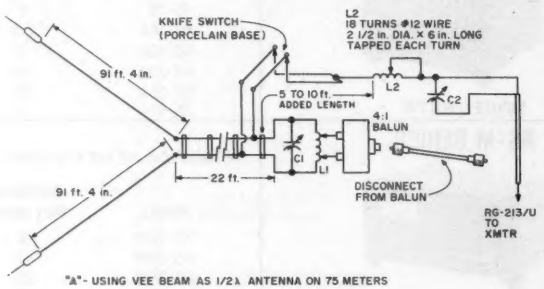
Orientation of Vee Beam Antenna

Radio waves travel from one point on the earth's surface to another by way of a great circle route. To produce the greatest signal strength at the distant receiving point, the front of the antenna field pattern must be aimed in the great circle direction of the receiver. The first step in the orientation procedure is to establish a true north/south reference line through the antenna site.

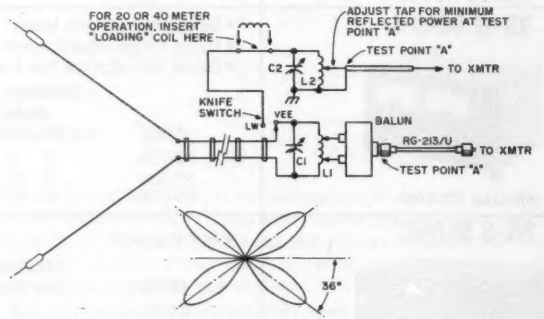
There are several methods that can be used to determine the direction of true north. If you have a good quality magnetic compass it will indicate the direction of the north magnetic pole. However, since the magnetic poles of the earth "drift" constantly, the compass indication must be corrected for any given time. You can usually obtain the amount of correction by calling your city or county surveyor's office or by contacting a civil engineering organization. For ages, the North Star has been used to determine the position of the north geographic pole. Today, however, due to air pollution, especially near large cities, it may be difficult to locate the North Star. There is another method—the use of the sun at true noon—that is very accurate and can be used on any day of the year when the sun shines.

At exactly noon (sun or standard time), at any place on earth, the sun bears due south in the Northern Hemisphere and due north in the Southern Hemisphere. Therefore, at high noon the shadow of a vertical pole or suspended vertical line is pointing due north in the Northern Hemisphere or due south in the Southern Hemisphere.

To precisely locate true north or true south, you must use a very accurate timepiece, preferably synchronized with time signals from WWV. The time indicated for noon must be corrected first from your antenna site location and second for the day on which the siting is accomplished. When these two corrections are applied, the resultant time is



"A" - USING VEE BEAM AS 1/2λ ANTENNA ON 75 METERS



"B" - USING ONE LEG AS 15 METER LONG WIRE FOR NON-DIRECTIONAL ANTENNA. EACH OF FOUR LOBES HAS ABOUT 2 dB GAIN. ALSO OPERATES ON 20 OR 40 MET. USING LOADING COIL.

Fig. 4.

DESIGN EVOLUTION IN RF P.A.'s

Now with GaAs FET Preamp

- Linear (all mode) RF power amp with automatic T/R switching (adjustable delay). Amplifier useable with drive powers as low as ½ watt.
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- Thermal shutdown protection incorporated
- Remote control capability built-in
- Rugged components and construction provide for superior product quality and performance
- All models include a complete operating/service manual and carry a factory warranty on all components
- Designed to ICAS ratings, meets FCC part 97 regulations
- Approximate size is 2.8 x 5.8 x 10.5" and weight is 5 lbs.

Specifications/price subject to change

MODEL [1]	FREQUENCY [2]	OUTPUT POWER	INPUT POWER	PREAMP	
	(MHz)	(W)	(W)	NF	GAIN
0508	50-54	170	1	–	–
0508G	50-54	170	1	.6	15
0510	50-54	170	10	–	–
0510G	50-54	170	10	.6	15
1410	144-148	160	10	–	–
1410G	144-148	160	10	.6	15
1412	144-148	160	30	–	–
1412G	144-148	160	30	.6	15
2210	220-225	130	10	–	–
2210G	220-225	130	10	.7	12
2212	220-225	130	30	–	–
2212G	220-225	130	30	.7	12
4410	420-450[1]	100	10	–	–
4410G	420-450[1]	100	10	1.1	12
4412	420-450[1]	100	30	–	–
4412G	420-450[1]	100	30	1.1	12

1. Models with G suffix have GaAs FET preamps. Non-G suffix units have no preamp.
2. Covers full amateur band. Specify 10 MHz Bandwidth for 420-450 MHz Amplifier.

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exactly solar noon, and the shadow of a vertically suspended line will be in the exact north and south position.

To correct your standard time for your location, consult a globe or an atlas to determine the longitude of your antenna site. An accuracy of about 15 minutes of longitude will be sufficient. The time correction to be applied is equal to one minute of time for each 15 minutes of longitude, or 4 minutes of time for each degree of longitude. The amount of correction will be determined by the difference in longitude between your antenna site and the particular meridian of longitude on which your local standard time is based. In the U.S., local EST is based on the 75th (75°) meridian of longitude, local CST is based on the 90° meridian, local MST is based on the 105° meridian, and PST is based on the 120° meridian. The 120° meridian passes through Nevada, a few miles west of Reno. The W6TYH antenna site is located on the 121° meridian of longitude; I'll use that location as an example.

Standard times (EST, CST, MST, and PST) are legal or official times but are not necessarily solar or sun times. For example, on June 16th of any year, at 12:00 noon local standard time on any time-base meridian, the sun will be directly overhead and the local standard time and the solar time will be the same. However, for a site located west of the time-base meridian, true solar noon will occur at a time earlier than the legal or official time noon.

For example, W6TYH is located west of the PST time-base meridian (120°). Therefore, on June 16th of any year, true solar noon will occur at the W6TYH antenna site at exactly 12:04 p.m. PST, since I must add 4 minutes for each degree of longitude. If the antenna site had been located on the 119° meridian, east of the time-base meridian, I would have had to subtract 4 minutes, and true solar noon would have occurred at 11:56 a.m. PST (actually 12:56 MST, because the 119° meridian lies within the MST zone). This time correction is referred to as longitude time correction.

The orbit of the earth around the sun actually is not a circle but an ellipse. You must add a second correction because of the varying motion of the earth in its orbit with respect to the sun. The necessary corrections for various dates throughout the year are calculated and presented in Table 3. When the correction is preceded by a plus sign, the correction should be added to the local standard time. When the correction is preceded by a minus sign, the correction should be subtracted. This time correction is referred to as seasonal time correction.

To illustrate the use of both the longitude and seasonal time correction, let's assume that the date on which the observation is to be made is June 26th of any year. Referring to Table 3, the seasonal time correction for this date is found to be plus 2 minutes. Since you must add 4 minutes for longitudinal time correction and another 2 minutes for seasonal time correction (for a total of 6 minutes), the exact instant of true noon will occur at W6TYH on June 26 of any year at 12:06 pm PST. Note that all local times are standard and not daylight-saving time.

Now that the preliminaries have been taken care of and you have determined the exact time of true solar noon at your antenna site, you can use this information to lay out a true north and south reference line through your antenna site—from there you will be able to determine accurately great-circle path directions to any point on the earth. The accuracy with which you are able to predict the point on the globe where your antenna field will be maximum will depend largely on your skill in laying out the reference lines through your antenna site and on a great-circle map or globe.

For the next step, you'll need a perfectly straight piece of pipe about 6 to 10 feet long. At the center of the antenna site, dig a hole about 10 or 12 inches deep. Stand the pipe in the hole and fill the hole with soil, tamping it to hold the pipe upright; check it with a carpenter's level to make sure that is it absolutely plumb (straight up and down). Tie a nylon cord around the pipe and stretch it out about 10 to 20 feet to the north. Watch the time, and at the exact instant of true noon, drive a rod or stake into the ground at the end of the pipe's shadow. Stretch the cord from the pipe to the top center of the stake. The cord is now stretched along your true north-south line.

If you have followed these instructions carefully, this line will point to the geographical poles of the earth with an accuracy within a few degrees. The line may be projected in each direction as far as you desire. Once established, a true north-south reference line is permanent and will always point to the geographical poles of the earth.

Since great-circle maps are not usually available for specific locations, use a globe for the next step. A low-cost student's globe made from pressed cardboard is best for this purpose. These globes have a center post at each geographical pole. Tie one end of a white thread around the north pole center post, dress it down over your location, wrap it around the south-pole center post, draw it taut and secure it in position. Stick a straight pin in the globe at your antenna location.

Stick another pin in the globe at the distant point to which you wish to transmit your signal. Stretch another thread between the two pins representing your antenna site and the distant receiving point. With a protractor, measure the angle of the bearing between the true north reference line (thread) and the line from your location to the distant receiver. Transfer the data obtained from the above measurements to the actual north-south reference line through your antenna site and determine the direction of the apex bisector line of your vee beam accordingly. ■

"When You Buy, Say 73"

The Match Maker

Everyone knows that antennas and transmitters should "match." But what exactly is that? And how is it achieved? Here are the answers.

Calvin McCarthy VE3LMP
98 Windsor Street
Thunder Bay, Ontario P7B 1T7
Canada

The need to find the "perfect match" is all-pervasive in life. The mechanic must fit a bolt to its matching nut. The worried mother strives to match her wonderful daughter with the perfect husband, and the radio amateur tries to create the perfect match between his exciter and amplifier, between his amplifier and his transmission line, and between his transmission line and antenna.

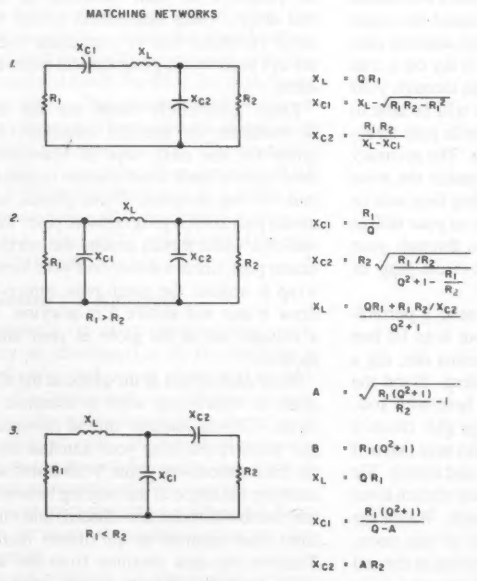

Fig. 1. These matching networks can be used to provide a match with maximum power transfer between unequal resistances.

What is all this concern about the perfect match? The mechanic's concern is obvious. None of us would suggest trying to fit a coarse-threaded bolt to a fine-threaded nut. Comments about the mother's concerns are best left to advice to the lovelorn, so we will discuss the concern of the amateur and leave mother to her fears.

Why Matching?

First we will discuss the reason for considering the matching problem. Efficiency of operation is always a concern. Why use more power than necessary to get the job done? There is a rule in electrical theory which says that you get the most energy into the job to be done (maximum power transfer) when the resistance of the source of the energy (signal generator) is equal to the resistance of the job to be done (load).

You can easily verify this with a few calculations. In Fig. 2 you see calculations done for a 10-volt generator with a resistance of 10 Ohms. As you look at the power-output figures, you will observe that the output power peaks at 2.5 Watts. Also observe that this occurs when the load resistance is equal to the generator resistance. If you are quick, something else will have crossed your mind. With maximum power transferred to the load, there is the same amount of power dissipated in the generator resistance. Only 50 percent of the power from the generator has reached the load. The other 50 percent has been lost as heat in the generator.

How is this important to us? If we are creating a signal in a generator, a vfo, a transmitting exciter, a kilowatt amplifier, or in a transmission line and we want the maximum power supplied to the load, we must make sure that the equipment which is supplying the energy has the same output resistance as the load resistance. For example, if your transceiver has an output resistance which looks like 50 Ohms, then to get maximum power transferred into the input of your kilowatt, the input resistance of the kilowatt must look like 50 Ohms as well.

Fig. 3 illustrates the idea. V_{gen} is the signal created by

GENERATOR RESISTANCE 10Ω
INPUT VOLTAGE 10V

POWER IN LOAD $= (I_{LOAD})^2 R_{LOAD} = \left(\frac{V_{IN}}{R_{GEN} + R_{LOAD}}\right)^2 R_L$

R_L Ω	P_{OUT} (WATTS)
1	.82
2	1.39
3	1.77
4	2.04
5	2.22
6	2.34
7	2.42
8	2.47
9	2.49
10	2.5 ← MAXIMUM POWER INTO THE LOAD
11	2.49
12	2.48
13	2.46
14	2.43
15	2.4
16	2.37
20	2.2
30	1.87
40	1.6
50	1.39
60	1.22
80	.99

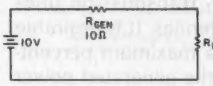

Fig. 2.

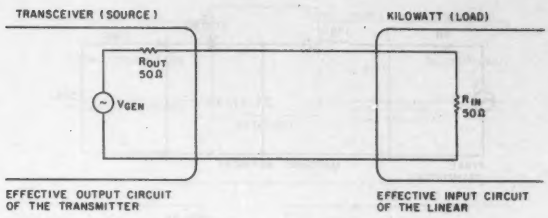

Fig. 3.

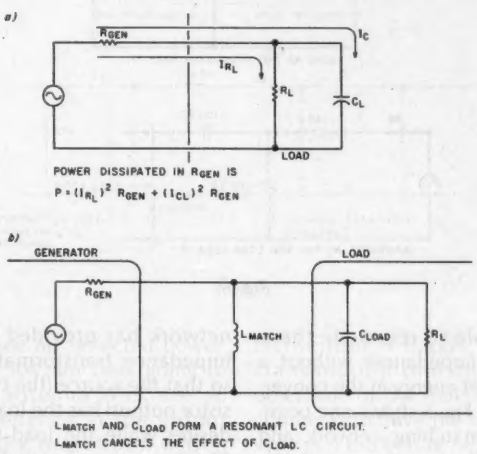

Fig. 4.

the final amplifier of the transceiver and R_{out} is the *equivalent resistance* of the same circuit. If you went into your final amplifier you would not find this as an actual resistor, but the circuitry which is there can look as though it were exactly a single resistance. Looking at the kilowatt input, the R_{in} is not an actual resistor either, but all the circuitry attached to the input looks like this single resistor if all you can do is measure it at the input terminal.

Another place where this is important is at your antenna. If your antenna terminals (the load) look like 75 Ohms to the signal generator (the output of your coaxial transmission line), then to get maximum power into the antenna the transmission line must look like 75 Ohms where it attaches to the antenna.

The perfect match we are thus looking for is a condition where the signal generator appears to have the same resistance as the load. This gives the desired maximum power transfer.

Loads With Inductors and Capacitors

If all circuits were resistive, then the matching problem would be reasonably simple. In radio-frequency circuits, however, we find capacitors and inductors as well. How do they affect our perfect match? An inductor or capacitor does not dissipate energy. All either of these does is absorb energy, then release it again later at a time when it is inconvenient.

Consider the loads of Fig. 4. They contain a resistor which will dissipate energy (do work) and a capacitor which accepts current from the generator and then puts it back into the system at a later time. This current, I_C, which flows through C must flow through R_{gen} as well, where R_{gen} dissipates energy ($I_C^2 R_{gen}$). This is energy lost without any work being seen for its loss. Remember how with just a resistive load energy was lost in the generator resistor as well, but at least some work was gained. This loss was acceptable but the losses created by the current through the capacitor are not acceptable.

The unacceptable loss of energy through the capacitor current (and the same thing would result if the capacitor were changed to an inductor) suggests that this reactive component should be removed from the circuit. This component may, however, be fixed in the circuit and not removable. Is a match possible with this situation? Yes, we can use our knowledge of resonant LC circuits to neutralize the effect of the reactive component.

If a capacitor, inductor, and resistor are combined to create a resonant circuit at the frequency where the reactance of the capacitor is equal to the reactance of the inductor (resonant frequency), the circuit will look to the generator as though this were only a resistive load. The current flowing in the capacitor would be cancelled by the current in the inductor and the only current flowing through the R_{gen} would be resistive current.

The circuit of (a) in Fig. 4 is not desirable for maximum power transfer, yet neither the generator box nor the load box can be modified. Consider now (b) in Fig. 4. A match has been created by attaching L_{match} in parallel with the load to cancel the effect of C_{load}. Now a condition where maximum power transfer is possible has been created.

This expands our condition for maximum power transfer to say that the generator resistance must be equal to the apparent load resistance and any reactive component in the generator must be matched by the opposite reactive component in the load ($2\pi fL = 1/2\pi fC$).

Different Output and Input Impedances

If this were all there is to matching, it would be an elementary problem. Life is never so simple, however. Matching involves providing a maximum power transfer from a generator of maybe 5 Ohms to a load of 50 Ohms. This is the problem of matching a power-transistor collector to a coaxial transmission line. To get the maximum power transfer out of the transistor, the transistor must be driving a load of 5 Ohms. But the load is 50 Ohms! To get maximum power transfer into the 50-Ohm load, the load should think it is being driven by a 50-Ohm generator. Our generator is only 5 Ohms! How are these two incompatible impedances reconciled?

The LC matching network

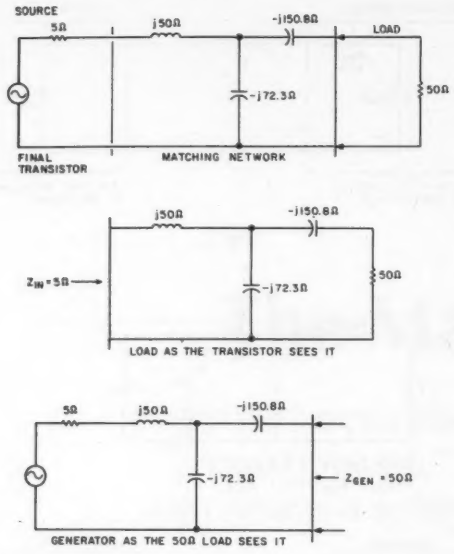

Fig. 5.

is able to reconcile these two impedances without a loss of energy in the conversion. Fig. 5 shows one possible matching network and its effect on the circuit. We will argue that the generator is the final transistor of a power amplifier. The LC network is the matching network. The load is a 50-Ohm coaxial cable feeding a 50-Ohm antenna. The transistor thinks its load is the combination of the matching network and the 50-Ohm coaxial cable. This apparent load looks like a 5-Ohm resistor at the frequency of operation. To the 50-Ohm transmission line, the matching network and transistor together appear to be its generator, and this combination looks like a 50-Ohm source resistance. The matching network has provided the impedance transformation so that the source (the transistor output) has the load it desires while the load (the 50-Ohm transmission line) has the generator it expects for maximum power transfer.

Your Place in All This

Can a radio amateur use this matching theory? You use it every time you tune your final, dipping the plate current and increasing the load coupling. Dipping the plate is effectively adding reactive impedance to the tuned circuit to cancel the opposite reactance which is in the circuit. Increasing the load coupling is bringing the effective load impedance to equal the effective source impedance.

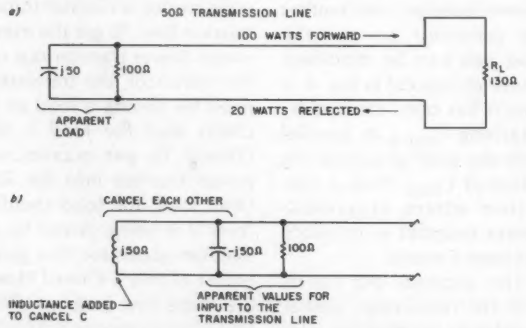

Fig. 6.

Transmission Lines and Matching

The problem of the perfect match also rears its head in transmission lines and antennas. It is desirable to get a maximum percentage of the generated power to the antenna.

Transmission lines such as a coaxial cable are very interesting components. If the cable is one thousand miles long, then its input terminals look like a resistor. A generator attached to this input appears to have a resistor for a load. Now if the cable is much shorter, more like the length we would use, but the far end of the cable is terminated in a resistor equal to the resistance which the very long cable looks like (the characteristic impedance of the line), then the input would still look like the same resistor. All energy put into the coax would travel down the coax and be used in the termination resistor (load).

But now the interesting phenomenon! If the load at the far end of the transmission line is not equal to the characteristic impedance of the line, all of the energy put into the input would travel down the transmission line but not all of it would be absorbed by the load at the far end. Some of the energy is reflected—sent back the way it came. Here we do not have maximum power transfer. All of the energy is not used in the load. Some of it travels back to the transmitter again, and now the transmission line becomes a signal generator with the reflected signal as the signal and the transmitter output device becoming the load. This returning energy would be used to heat the plate of the final or heat the transistor heat sink.

What if you have a high vswr on your transmission line and 20 Watts is sent back from the load which was sent 100 Watts by the transmitter? How can you protect your finals from this vswr of 2.6? Fig. 6 shows a possible situation which could cause this. The antenna with its impedance of 130 Ohms is connected to the 50-Ohm transmission line. For reasons explainable by transmission-line theory, we will say for our example that the input end of the transmission line looks like a resistor of 100 Ohms in parallel with a capacitor of 50-Ohm capacitive reactance. This near-end impedance is the load presented to your transmitter.

The transmitter connected to this point cannot tell the difference between the end of the coax and a real resistor and capacitor of our example value. Again we use a matching network as our solution. The effect of the capacitance can be cancelled by using an inductor to make a resonant circuit. Fig. 6 (b) shows this inductor added to make the input look like a resistor only. Now we have a resistive load which will accept power without causing extra final heating.

Tube Final Match

If your transmitter has a tube final, its pi network will be able to convert this 100-Ohm apparent resistance to the tube output impedance while adding the necessary inductance to cancel the capacitance. Fig. 7 shows a pi-network solution (network 2 in Fig. 1) which creates this match from our transmission line to a 1000-Ohm tube output. Notice that X_{C2} in Fig. 1 is made of two capacitors. One is the transmission line's apparent capacitance and the other is a real capacitor found in the matching network. Looking into the network where it attaches to the coax, the network would look like 100 Ohms of resistance in parallel with a 50-Ohm inductor. We have a good match to our coax input and it cancels the capacitance of the load.

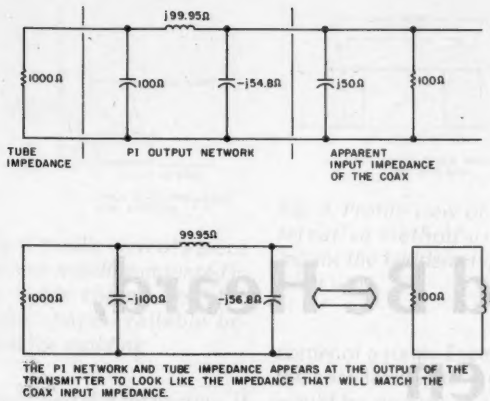

Fig. 7.

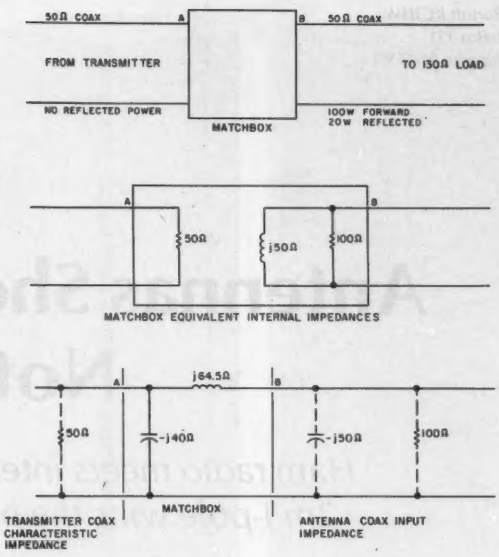

Fig. 8.

Transistor Final Match

For the modern amateur, this pi-network solution is not possible. Solid-state final transistors have an output impedance of maybe 1 Ohm and broadband transformers are used to transform this to an output impedance of 50 Ohms. The solid-state power amplifier must have a 50-Ohm load presented to its output by the transmission line. We will still consider our same problem and see how we can create a desired match with an antenna tuner or matchbox.

Fig. 8 shows the desired situation. The 50-Ohm coax from the transmitter must be terminated in a load at A which looks like 50 Ohms. This will make the transmitter see no reflected power. The 50-Ohm coax going to the antenna must see an impedance at the output of the matchbox which matches the 100-Ohm resistance in parallel with the 50-Ohm capacitance appearing at its input. This will give our desired maximum power transfer into the antenna transmission line.

An L network will provide the conditions to match both transmission lines effectively. If we could measure the impedance looking into port A (using an antenna noise bridge would work) we would be able to measure a 50-Ohm impedance and the transmitter would be able to put all its power into this resistive load. Looking into port B of the matchbox, we would be able to measure a 100-Ohm resistance in parallel with a 50-Ohm inductor, just the impedance we need for maximum power transfer into the antenna transmission-line impedance.

This example describes what you are doing when you adjust your antenna matching unit. The transmission line on the transmitter side of the matchbox has no reflected power in it so the transmitter is happy. The transmission line on the other side of the matchbox continues to have the same vswr as it did before but the matching network makes maximum power transfer possible from the transmitter into the antenna transmission line. Notice it has not made maximum power transfer possible into the antenna itself. To get this condition there would have to be something done to match the transmission line to the 130-Ohm antenna. Here the same principles of matching hold as we have already discussed. Get the driving impedance to look like a resistor equal to the load and cancel any reactive components in the circuit.

Conclusion

The "perfect match" in rf circuits is desirable and possible. Although you will make contacts without it, you will put less stress on your equipment and put more signal into the air if you study these principles and use them. Hopefully, this article has given an understanding of what happens when you tune your equipment and what causes the change in vswr as you adjust your transmatch. ■

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Jim Burtoft KC3HW
RD 2, Box 131
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Antennas Should Be Heard, Not Seen

Ham radio meets interior decorating! KC3HW's 2m J-pole wins the prize for unobtrusiveness.

To anyone but a ham, an antenna is a blot on the landscape. Those not in the amateur fraternity fail to see the beautiful symmetry, the subtle technique, and the reliance upon natural laws to which our skywires conform. Perhaps if we were to pose as artists rather than amateurs and call our creations "wire sculptures," the neighbors would be more tolerant.

I ran into this no-antenna problem upon purchasing my first two-meter rig. In my case, this was a hand-held. I picked the hand-held because of its greater utility. A hand-held can double as a mobile or base rig, but mobile and base rigs don't make very good hand-helds. Unfortunately, the decision brought an unforeseen problem.

At home, the hand-held and rubber ducky combination had only enough output to access the two local repeaters. On simplex, it was good for three miles (in Pennsylvania we have these natural rf absorbers called hills). It didn't seem right to me to spend all that money for eight hundred channels and then confine myself to only two.

I tried a 5/8-wave whip, but that was awkward. It made the hand-held top-heavy and frequently hit the walls and ceiling.

An outside antenna was out of the question. Our house wore a "For Sale" sign, and my wife already had trimmed the antenna farm down to one obscure forty-meter dipole. She absolutely refused to hear about another antenna on the house.

This unhappy set of circumstances forced me to begin scanning the literature on indoor two-meter antennas. In doing so, I discovered something that most hams living in apartments and condominiums must already know. It's this. Few two-meter-antenna designs are intended for permanent indoor installation. Those that can be adapted are too ungainly for the average wife to accept as a long-term addition to the decor. Hasn't anyone developed a permanent indoor antenna for two that's aesthetically acceptable?

Not finding a ready-made answer, I developed the Hidden Hypo described below. If you're an apartment dweller looking for an antenna with substantial gain over a rubber ducky, then

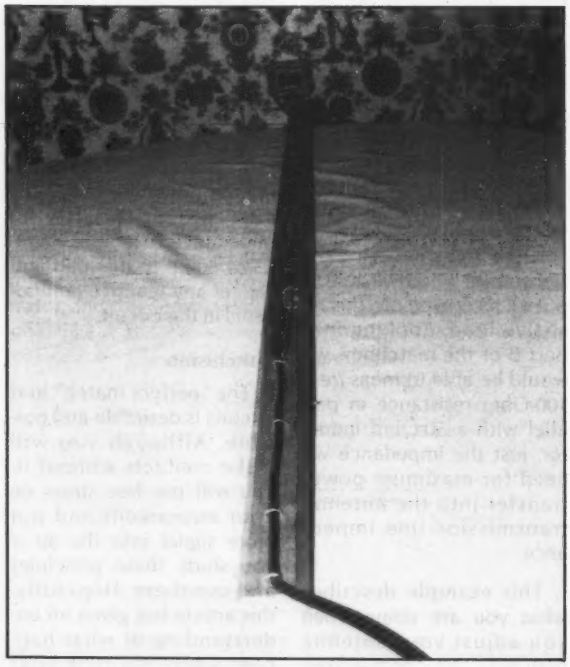

Photo A. The assembled Hidden Hypo (laid out on a bed) is mounted on the back of a piece of cove molding. Note that the coax is fastened to the back of the trim.

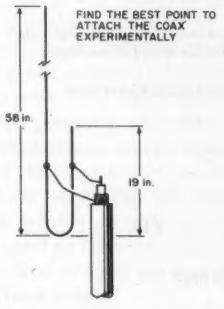

Fig. 1. The Hidden Hypo is really the well-known J-pole design. The spacing is not critical, but do keep the two legs parallel.

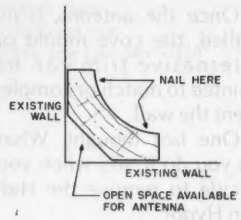

Fig. 2. Profile view of a piece of cove molding mounted in an inside corner. Note the open space available behind the molding.

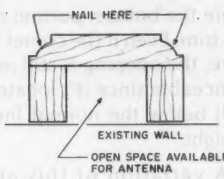

Fig. 3. Profile view of an alternative method used to mount the Hidden Hypo on a flat wall.

you'll find this interesting. If you're among those blessed with a good antenna, then the Hidden Hypo makes an excellent secondary antenna. Put it in the family room and monitor two meters while you sit and watch the game!

Design Considerations

King Solomon once said, "There's nothing new under the sun," and that's true for the Hidden Hypo as well. The basic configuration is the popular J-pole. However, while the design is well known, this antenna adds a couple of new wrinkles to it.

The first wrinkle is drastically reduced element spacing. Orthodox J-pole designs call for elements spaced three or more inches apart. The Hidden Hypo reduces this to one half inch.

At first thought, it may seem that bringing the elements this close together might create some undesirable interaction, but it doesn't. I experimented with spacings down to almost zero with good results. One half inch was chosen as a compromise. It was small enough to do the job yet wide enough to make construction easy.

The second wrinkle involves the method used to mount the antenna. The thin needle-like design (hence the name, Hypo) allows it to be hidden in places previously not possible.

Now, if this antenna were mounted on the back side of a piece of cove molding, the entire unit would fit in the corner of a room. Except for the coax leading to it, there would be no way of telling that an antenna was there.

For those not familiar with the construction industry, cove molding is most commonly used to trim a room where 12" x 12" ceiling tile has been installed. The trim (for our purposes) has three important features. First, it's nearly symmetrical, allowing it to be used as inside corner trim. Second, when installed, there's an open space behind it large enough to accommodate the antenna. Third, it's a commonly available material. The cove molding, along with the rest of the material used to construct this antenna, is available at most home-center stores and lumber yards.

Construction

The principal material used to construct the antenna is a seven-foot piece of 14-gauge insulated wire. I obtained mine by cutting it out of a piece of Romex electrical cable.

Pull the wire taut so that it's straight and then cut it to 77 inches. Measure up 19 inches and fold the wire back over on itself. You should end up with a U-shaped wire with one leg 19 inches and the other 58 inches.

From the fold, measure up 3-1/2 inches on each leg. Strip the insulation off each leg from this point to 7 inches above the fold. The antenna configuration is now complete and ready to be mounted onto the back side of the cove molding.

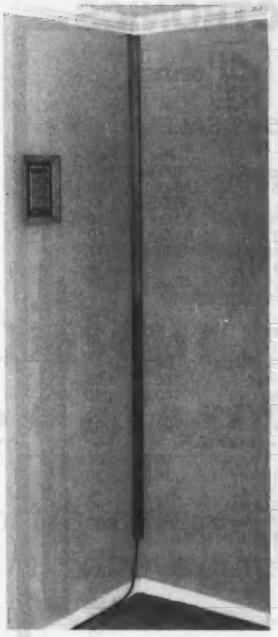

Photo B. Now you see it... The Hidden Hypo is mounted on the back of this piece of unpainted trim.

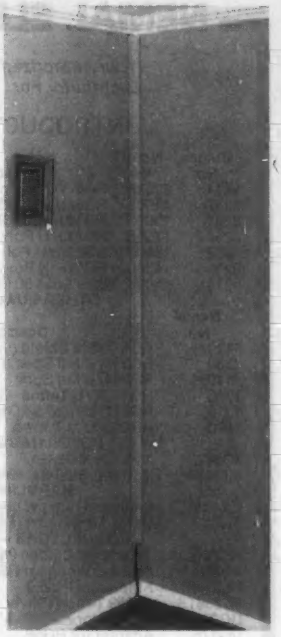

Photo C. Now you don't. The painted trim blends in with the rest of the room.

Lay the 58-inch leg on the cove molding and fasten the upper portion only. The section stripped of insulation and the 19-inch leg must remain free.

I used an Arrow T-50 staple gun and 9/16-inch staples to fasten the antenna. If you don't have access to a similar gun, you may choose to fasten the antenna using electrical wire brads.

Before completing the fastening process, carefully align the 19-inch leg so that it's parallel to the longer leg and spaced no more than 1/2 inch from it. If you get things too wide, the antenna will interfere when mounting the trim in the corner. It is *most* important to keep the spacing uniform. Don't let the elements assume a vee shape or belly apart. Nonuniform spacing will cause wild fluctuations of the swr meter when matching the coax to the antenna.

Next, expose the braid and inner conductor of the coax. Wrap but don't solder the braid to one leg and the inner conductor to the other leg. Apply power to the antenna and slide the coax up and down the uninsulated section of the antenna. At some point, the swr meter will dip. Solder the coax to the antenna at that point.

If you don't have a VHF swr meter available, you can solder the coax 5 inches above the fold. That will be close, but I recommend the meter method.

Finish fastening the antenna to the cove molding, being careful to preserve the alignment of the antenna elements. Use the 9/16-inch staples to fasten the coax to the cove molding, also.

Next, trim the molding so that it is an inch or two shorter than the length of the corner that it will fit in. Use this gap at the bottom to draw the feedline out from behind the molding.

At first, this might not seem aesthetically acceptable, but the situation isn't bad. In most cases there's something there to hide the opening. Corners naturally attract chairs, tables, and lamps which tend to ob-

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scure the bottom portion of the trim. Even if the corner is bare, the opening is still not noticeable since it's located well below the normal line of sight.

A variation of this approach can be used if you wish to mount the Hidden Hypo on a flat wall. Here, you'll have to use one piece of panel trim. (This trim may go under a number of names—check Fig. 3 for its profile; it's technically called WP-982) and two pieces of parting stop. Both pieces or their equivalent should be available at your local home-center store.

Mount the trim pieces as shown in Fig. 3. Drive finishing nails in just far enough to hold the pieces together. Mount the Hidden Hypo behind the assembly just as behind the cove mould. Place the entire assembly on the wall and continue to drive the finish nails through the trim and into the wall.

Once the antenna is installed, the cove mould or alternative trim can be painted to match or complement the wall.

One last thought. What do you do if and when you decide to remove the Hidden Hypo?

No problem. Make another trip to your local home-center store and pick up a small can of vinyl spackling compound. It will fill any holes that you may have left. Follow the instructions on the can.

Conclusion

The Hidden Hypo is an easily-constructed antenna for two meters. It's vertically polarized and omnidirectional. Perhaps the nicest part is that it provides a reasonable alternative for those like me who can't put up an outside antenna. It's not a twelve-element beam at fifty feet, but it sure beats the whips and rubber duckies! ■

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Brent D. Harry
5250 Grand Ave.
White Bear Lake MN 55110

A Connoisseur's Microwave Converter

Brent Harry set out to build not the cheapest but the best downconverter possible. Serious microwave buffs will thank him.

This article describes the design and construction of a new microwave converter for use with either the 6-MHz MDS or the amateur-television allocation, centered at 2.153 and 2.314 GHz respectively. With the broad tuning range of its local oscillator, this converter could be used elsewhere, although the design was optimized for 2.153 GHz.

Since there are so many pre-built units, kits, and plans already available, why another? This converter's performance is very respectable, and its design offers other advantages such as high reliability and simple construction for those who prefer to build their own; however, I obtain these results at the cost of high-quality components. For example, both the high-gain input amplifier and high-stability reflection oscillator use high-performance H-P HXTR-2102 microwave transistors, $31.00 each, wholesale. Fortunately, the other components are much less expensive.

I conceded the necessity of expensive microwave transistors only after building many subsections and complete models with inexpensive ones. I also built models with more expensive low-noise gallium arsenide MOSFET input amplifiers (which are nearly mandatory at the 22,000-mile geosynchronous satellite distance), but biasing is more difficult and they did not provide a noticeable improvement in reception quality at the relatively trivial distances involved here, so I chose the lower-cost bipolar devices.

All microwave circuitry was designed with the modern scattering-parameter approach, facilitated with an H-P S-parameter test set, 8566A spectrum analyzer, microwave frequency counter, test ovens, etc.

Some of the features are: easy construction and stan-

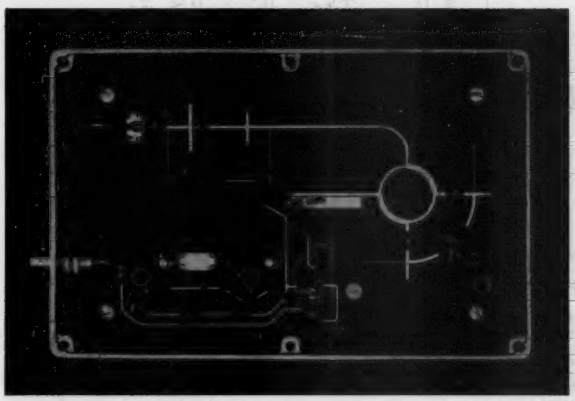

Photo A. This is what the circuit board looks like after being inserted.

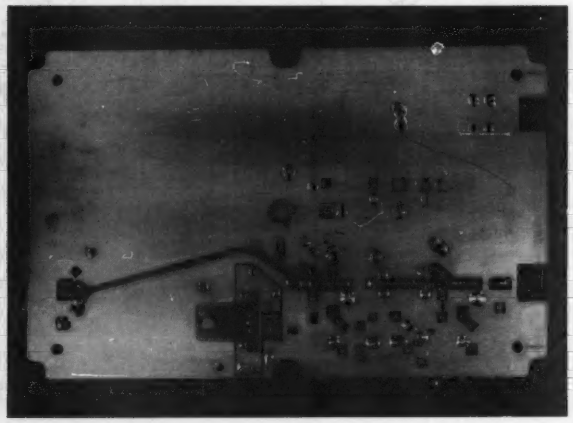

Photo B. The ground-plane side of the circuit board.

dardized performance with a double-sided etched board requiring no hand wiring, an input amplifier, a high-stability local oscillator, impedance matching for all microwave circuitry, an on-board regulator so that the variable tuning voltage affects only the local oscillator, and appropriate microwave-input connectors. All critical microwave tuning is predetermined by etched microstrip transmission-line segments.

The circuit board stands on ¼-inch spacers in a die-cast-aluminum case with a tight flange lid; the case is easily sealed with silicone rubber at the lid and the bases of the spacers if the correct rubber-gasketed connectors are used.

I taped a just-baked desiccant capsule (humidity absorbent) inside the cover immediately before sealing the case to prevent water or ice formation at cold temperatures. I used the indicating type which changes from blue to pink when it has absorbed its limit of water vapor. The photographed units were finished with almond-color epoxy spray paint. A light anodized finish would be more durable, although bare aluminum would be fine.

Of course, I don't claim originality for several aspects of this system, such as the use of the single downlead to supply dc power to the converter, dual-gate MOSFETs in the output amplifier, a parabolic dish antenna with a can feedhorn, or a commonly used hybrid junction (or "rat-race") mixer. I chose the circular form of this ring over the more common square form because the boundaries are more clearly defined. My earlier designs used a different ring with a differential output, driving a differential-input wideband IC amplifier; I finally accepted the present form as superior.

What about performance? Let me first say that I am wary of advertised high performance at low cost, especially when I see formed plastic. Since gain is an effective eye-catcher, insertion gain of the converter itself tends to be forsaken for system gain of the converter/antenna combination, especially when a reasonable-size parabolic dish can provide over 30-dB gain (measured with respect to a dipole). Of course, there is more to consider than gain, as noted ahead in the input amplifier section. Oscillator stability is one other measure of performance which is rarely advertised, and which I refuse to compromise.

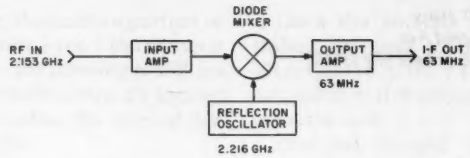

Fig. 1. System block diagram.

With a −70-dBm input at 2.153 GHz, the converter insertion gain is 38.0 dB with its output tuned to channel 3, centered at 63 MHz. An adjacent channel could be used instead. One could expect higher gain in actual use, driving a 75-Ohm television input instead of a 50-Ohm spectrum analyzer. Note that −70 dBm represents only 0.0001 microwatts since the 0-dBm reference is 1 mW into 50 Ohms; with 38.0-dB gain, the output would be 0.631 microwatts. I chose −70 dBm since it was slightly above the spectrum analyzer's threshold.

At 2.216 GHz, the off-to-on oscillator drift at room temperature is 0.3 MHz, indicating a stability of better than 0.014%, and drift over the temperature range −30° C to 60° C (−22° F to 140° F) is under 1.3 MHz, indicating a stability of

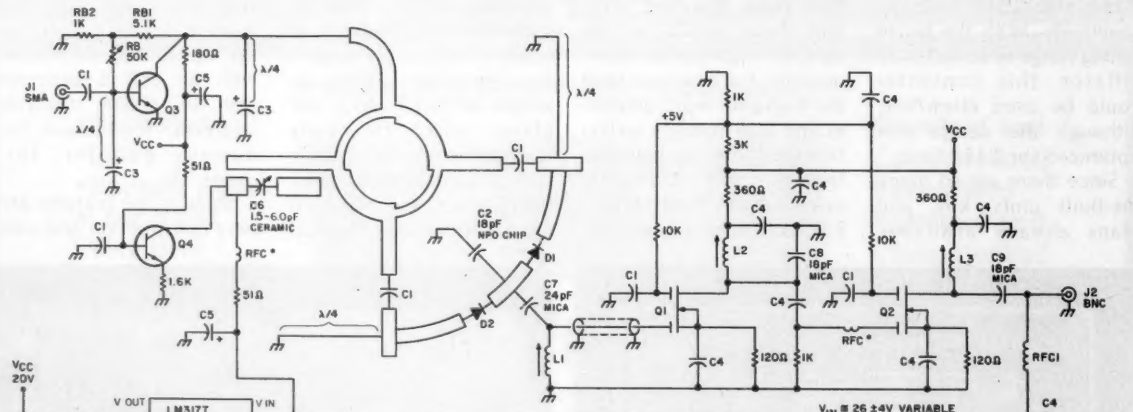

Fig. 2. Complete converter schematic.

better than 0.06%! I chose this temperature range since it should include any temperature seen in actual use.

Note: To achieve my measured gain and stability, it is essential to use high-quality (expensive) NPO chip capacitors which are qualified at 2 GHz. I've measured much higher drifts and lower gains while experimenting with other chip capacitors. The most important chip capacitors are at the base of the local oscillator and at the mixer, so at least those should be high quality. Expect to pay $5.00 to $10.00 apiece for appropriate capacitors.

I developed this project while living in Redondo Beach, California. This was a flat, indirect-signal location 32 miles from the transmitter in the LA area. I would have needed a tower for line-of-sight reception, so I used a 24-inch parabolic dish mounted on a camera tripod at ground level on the lawn. I could receive a fair (snowy but watchable) image in several directions because of reflections, but I had to aim at either the telephone lines or a large tree down the street in order to receive a good picture (one with easily-readable fine print). At this poor signal location, I could receive a fair picture even without the dish, or sometimes (depending on atmospheric conditions) a very poor one from inside the house, through the wall.

Aren't microwave signals strictly line-of-sight and severely attenuated by obstacles? Yes, and that is an indication of this converter's sensitivity. I've tested this setup at other locations: It produced an excellent picture at a good line-of-sight location 21 miles from the transmitter, and a fair one at a partially tree-blocked location 65 miles from the transmitter. Doubling a given parabolic dish's diameter will quadruple the received signal power.

The block diagram and schematic diagram of the system are shown in Figs. 1 and 2, respectively. Photos A and B are views of both sides of the completed circuit board to aid in parts placement. Figs. 3 and 4 are illustrations of the front and rear sides of the etched board.

I did the artwork on a 4× scale for the sake of precision. For those who prefer to etch their own, let me stress that as well as accurate alignment, the correct circuit board material and thickness are essential since both affect the various microstrip transmission-line impedances. The material is NEMA type-FR-4 flame-resistant glass-epoxy, with a relative permittivity (dielectric constant) of 4.5 at 1 MHz. The required thickness is 0.031 inches. The board should be electroless-plated with gold or silver after etching, since bare copper deteriorates.

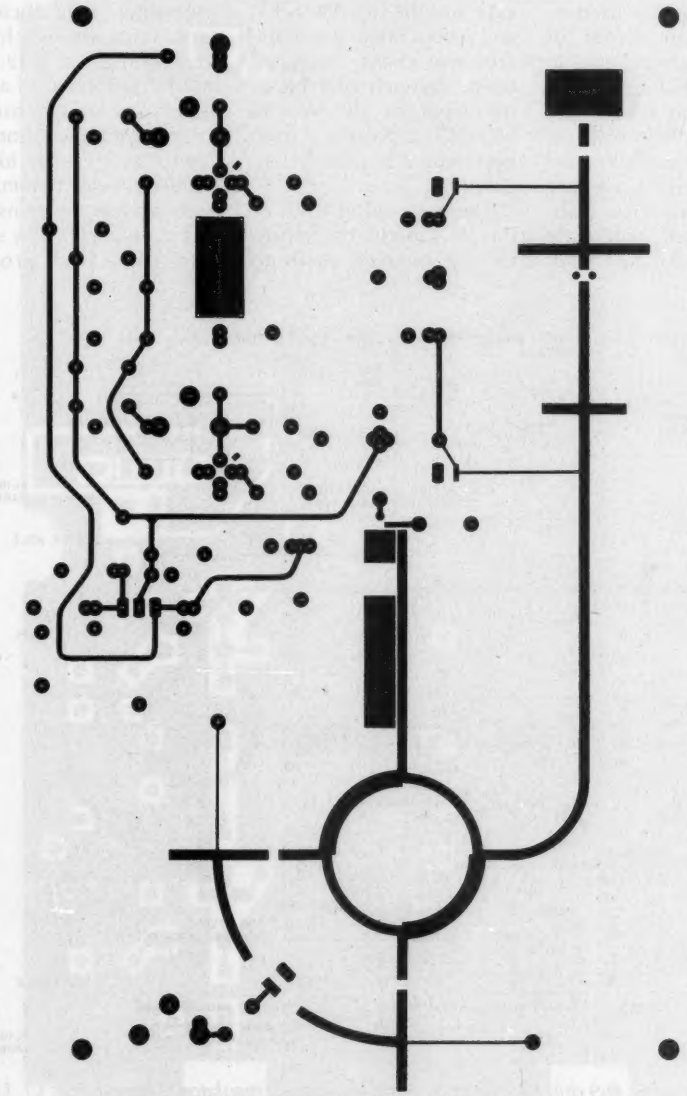

Fig. 3. Circuit board, component side.

As well as supporting the circuit board, the aluminum spacers in each corner also electrically connect the ground plane to the aluminum case. Therefore, the spacers are mounted to the case with screws and no protective spray or other insulator should be used; do not glue-mount the spacers.

To locate the holes, I taped two-sided adhesive tape in the bottom of the case, placed the circuit board with screwed-on spacers into the case so that the spacers stuck to the tape, then unscrewed the screws from the spacers. When the circuit board was lifted out, the spacers were still stuck to the tape in their necessary positions. I had only to outline each spacer with a pencil before removing it. If the box has been totally anodized, be sure to sand the areas where the spacers and connectors make contact with the case.

Since the dimensions of the aluminum case are large with respect to the input wavelength but very small with respect to the output wavelength, the output BNC connector can use the case for its ground connection, although the input SMA connector cannot. That is why there is a ground pad for the input microwave connection. Short pieces of bare 26-AWG wire are used to connect each corner of both square ground pads to the ground plane, as well as the ground side of the 18-pF mixer-diode chip capacitor, and the ends of the four thin quarter-wave bias stubs. The two mixer stubs are terminated with a dc ground, but the two input amplifier stubs are terminated with a chip capacitor to ground.

As shown in Photo B, the only components on the ground-plane side of the circuit board are: chip capacitors to ground at the base of the local oscillator and gate 2 of both MOSFETs; the voltage regulator, insulated from the ground plane with a mica washer and nylon screw; a short piece of 50-Ohm semi-rigid coaxial tubing used to connect the output of the mixer resonator to gate 1 of the first MOSFET; and a noncritical 2-turn microwave choke, wrapped on a 5/32-inch drill bit at the input of the second MOSFET to prevent it from becoming a microwave oscillator.

The two emitter leads of the local oscillator transistor are trimmed down to about 2 mm long before the base lead is gently bent to go through the board at a right angle. The two pads for the oscillator's emitter and base resistors are intentionally undrilled so that the ground plane is continuous in the vicinity of the oscillator's base lead, which is grounded with a chip capacitor on the ground-plane side. The input amplifier's two emitter leads are similarly bent to go through the board, but are soldered directly to the ground plane.

Another noncritical 2-turn microwave choke, wrapped on a 5/32-inch drill bit, is formed as an integral part of the oscillator's collector resistor. Be careful to correctly identify the collector terminal of each microwave transistor (cut at an angle). The separate regulator ground

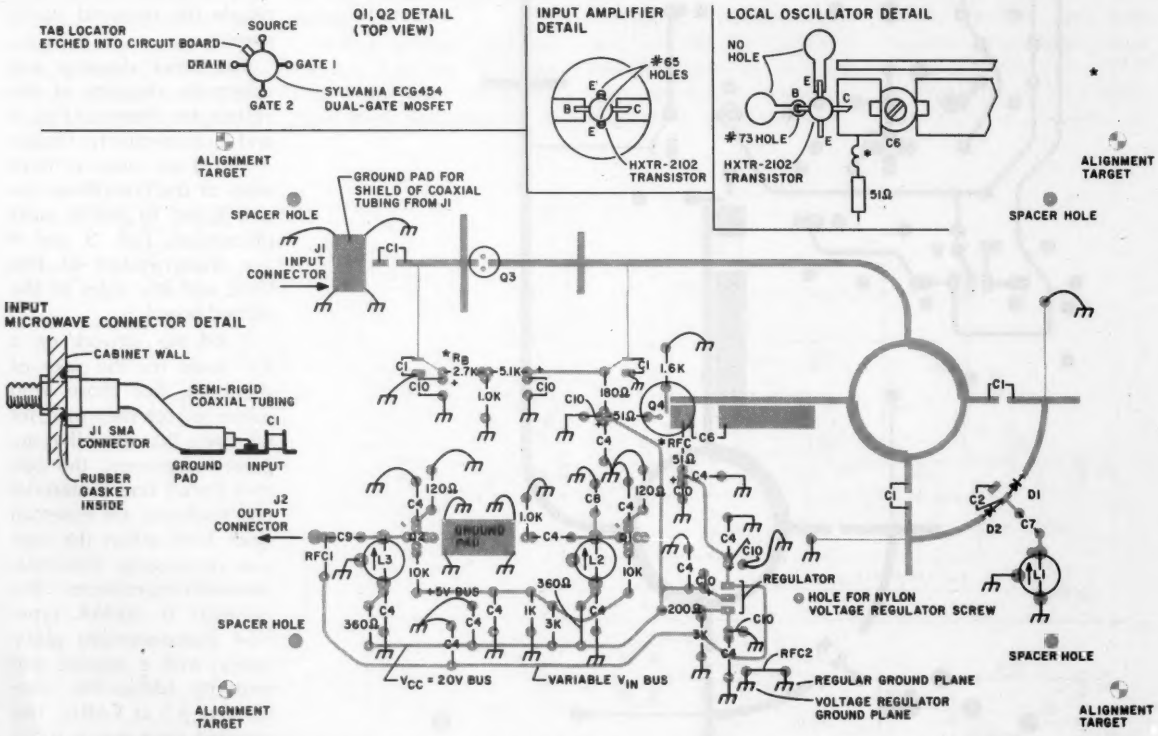

*Fig. 4. Parts placement, component side. Hole sizes: #69 drill bit except as otherwise noted: regulator (3 holes): #62; L1, L2, L3 (9 holes): #51; regulator and spacers (5 holes): #27; emitter leads of Q3 (2 holes): #65—locate centers with #80; base of Q4, 8 ground-pad corners, ground side of C2, and 4 ends of thin bias feed stubs (14 holes): #73. C1≥47-pF chip; C2=18-pF chip; C4=0.01-uF ceramic; C7=24-pF mica; C8, C9=18-pF mica. ★R_B is adjusted as explained in text. 2.7k is the initial value to start from. * 2-turn microwave rfc as explained in text.*

plane and solid tantalum capacitors are necessary because of the noise-generating regulator. Other types will not provide proper bypassing. The two ground planes are connected with a molded choke. Once the circuit board has been completed and screwed down on the spacers, the input and output connectors are soldered, and the converter is ready for tune-up.

Power Supply

The power-supply circuit of Fig. 2 is simple and noncritical, so I haven't illustrated the physical construction. Mine is built in an inexpensive cabinet with rubber feet, using terminal-strip hand wiring. The two connectors should be adjacent to each other with a good shared case ground. The supply provides approximately 26 V ±4 V to the converter, producing ample tuning range. One possible modification would be the addition of an antenna switch.

Mixer

The mixer has two inputs: the amplified input signal and the local-oscillator signal. The hybrid junction ring which couples these two inputs to the mixer diodes has four functions: (1) It isolates the signals from each other, (2) it provides a 50-Ohm load for each signal, (3) it allows each signal to divide equally in power between the two output arms (each diode receives two signals with respect to ground; the common connection of the two diodes looks like ground at microwave frequencies), and (4) it provides the proper positional phase relationships for these microwave input signals so that the mixer diode outputs reinforce each other.

A Smith Chart rotation and stub tuner transforms each diode's impedance to 50 Ohms so that the ring will operate properly and maximum power transfer will occur. This is why the mixer diodes are not connected directly to the output arms of the ring, as could be done if the diodes themselves were 50 Ohms. Unmatched designs do this, hoping to achieve 50 Ohms by driving 1 mA or more of noise-producing dc bias through the diodes. The correct method is to measure diode impedance at a particular absorbed (not incident) power, construct an appropriate matching network to transform that impedance to 50 Ohms, then adjust the local oscillator to provide the required absorbed power.

One very convenient method of monitoring absorbed power is to measure the "self-bias," which is the average rectified current driven by the local oscillator. To maximize mixer conversion efficiency, I chose 3-mA self-bias. My earlier models did use a small amount of dc bias, but this did not improve conversion efficiency whatsoever (which is not

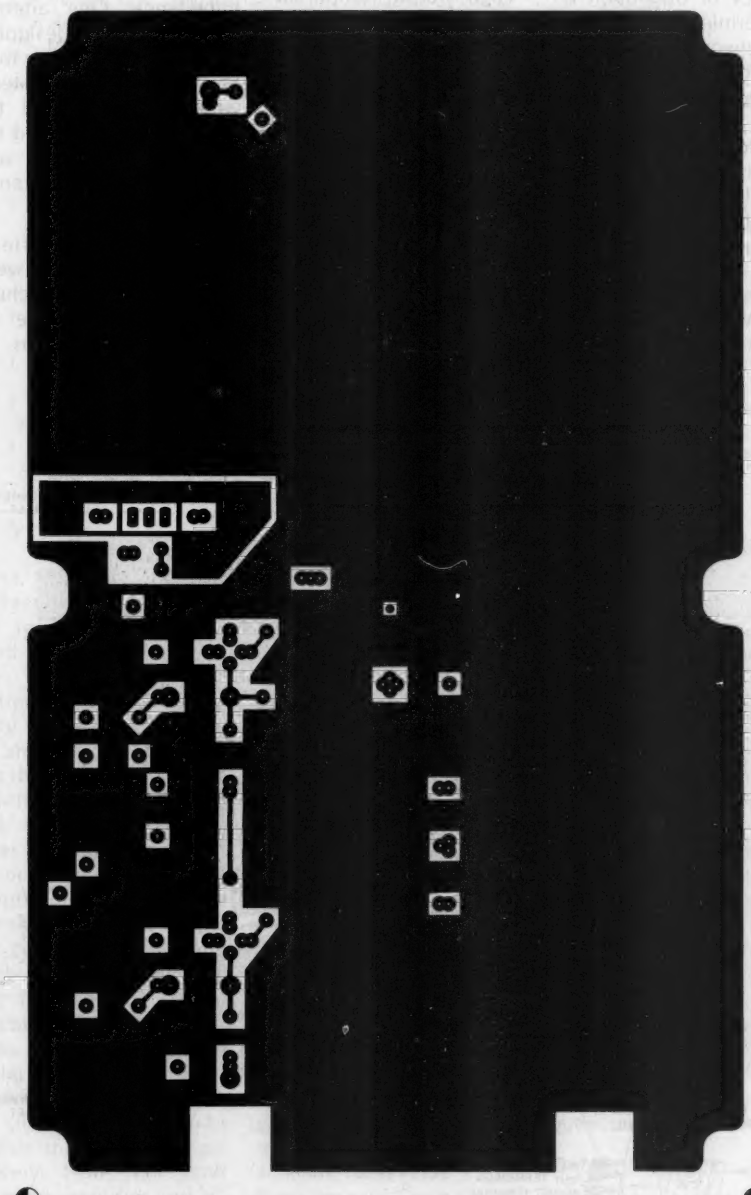

Fig. 5. Circuit board, ground-plane side.

true of all mixers). This mixer uses H-P 5082-2817 Schottky diodes, intended for low-noise, high-sensitivity mixing at 2 GHz. Using other mixer diodes would of course ruin the matching. If desired, the self-bias can be measured by cutting one of the bias stubs near its dc ground end, inserting a chip capacitor, and connecting a milliammeter across it (yes, current is made to flow from dc ground through two diodes, back to dc ground). The chip capacitor must be replaced with a short when finished to complete the dc return path. The diodes must be connected in series (either direction) for a dc path to exist.

Local Oscillator

The tuning range of this oscillator is approximately 1.8 to 2.4 GHz with the power supply set at mid-range. Because of the unusually large emitter resistor and emitter-resistor voltage (large dc negative feedback), the dc operating point of this transistor is held very constant over wide variation of the temperature-sensitive dc beta and V_{be}. This and the mode of oscillation produces the high stability already mentioned.

As stated earlier, this is a reflection oscillator. The frequency of oscillation is not determined by a feedback network; there is no feedback. The base is grounded with a chip capacitor and the collector serves as both the input and output. Looking into the collector, there is a range of frequencies over which the reflection coefficient is greater than one, indicating negative resistance. When attached to a resonant circuit with the correct reflection coefficient (in this case, a series-tuned microstrip segment), the transistor oscillates. The oscillator is capable of a much higher power output, but its bias network should not be modified since its power output affects the mixer-diode impedance for which the matching network was designed.

Input Amplifier

High output amplification will do nothing to better a system with a poor noise figure; however, high input amplification can cut a system noise figure in half while doubling system gain. System gain is the sum of stage gains in dB, but a system noise figure is more involved:

$F_{system} = F_1 + (F_2 - 1)/G_1 + (F_3 - 1)/G_1G_2 + (F_4 - 1)/G_1G_2G_3 + \ldots$

where F and G are stage noise figures and gains (power ratios, not dB).

An input amplifier is beneficial in terms of noise figures as well as in terms of sensitivity, gain, and oscillator-antenna isolation. There are many different criteria to choose among in microwave-amplifier design. This one uses narrow-band matching to achieve maximum power transfer into the 50-Ohm load while providing a 50-Ohm-input impedance. One alternative approach, designing the input amplifier for minimum noise figure instead, would have reduced the gain, possibly increased the system noise figure, and required precise antenna matching.

The input amplifier's S-parameters which were used to design its matching stubs are sensitive to changes in the dc bias. In

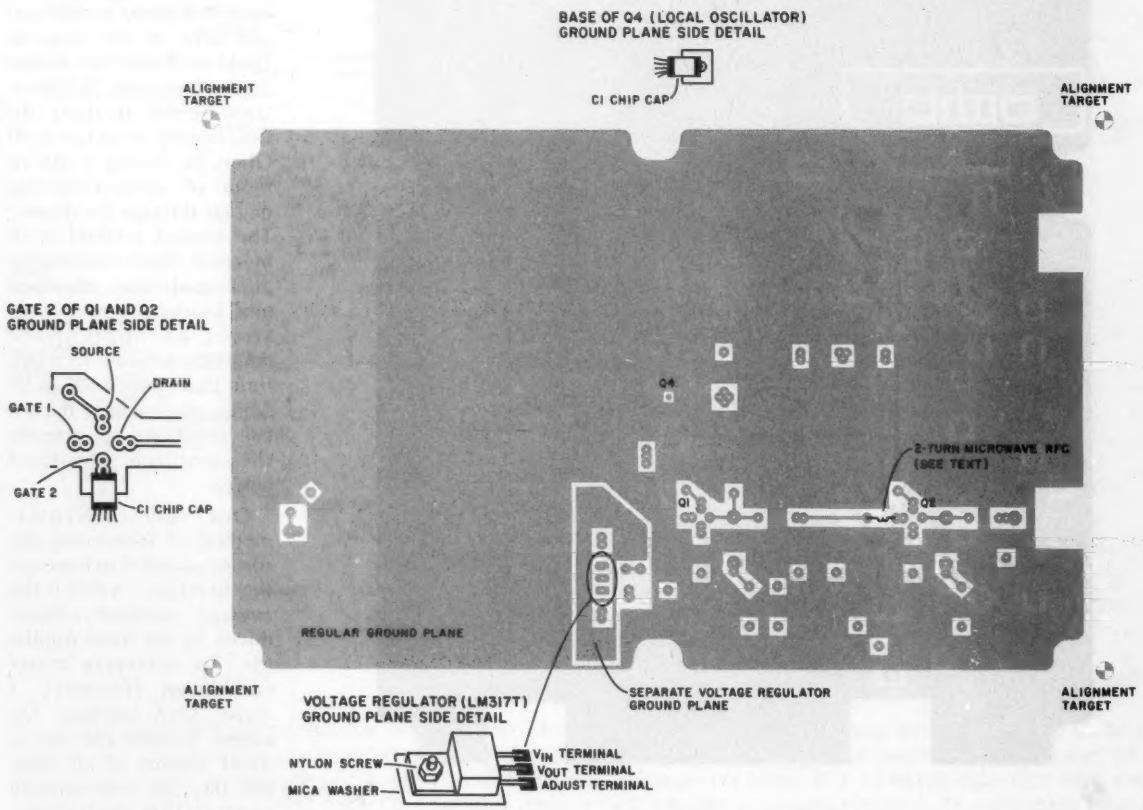

Fig. 6. Parts placement, ground-plane side.

Parts List

2	Microwave transistors: Hewlett-Packard HXTR-2102
2	Schottky mixer diodes: Hewlett-Packard 5082-2817
2	Dual-gate MOSFETs: Sylvania ECG-454 or similar
2	LM317T voltage regulators
3	.28- to .42-uH slug-tuned inductors (Q = 70 @ .35 uH & 63 MHz): Gowanda Electronics TC-330 or similar
3	22-uH molded chokes: Gowanda Electronics 8/222 or similar
2	Gold-plated female SMA connectors with rubber gasket, for 0.085" semi-rigid tubing: Amphenol 901-9210-2
2	Gold-plated male SMA connectors for RG-316/U coax cable: Omni-Spectra OSM 601-3
1	Female BNC bulkhead connector with rubber gasket: Amphenol 31-102 or similar
1	Female BNC bulkhead connector: Amphenol 31-221 or similar
2	Male BNC connectors for RG-59/U coax cable: Radio Shack 278-104 or similar
2	F-59 connectors for RG-59/U coax cable: Radio Shack 278-211 or similar
1	F-61 connector: Radio Shack 278-212 or similar
6"	0.085"-diameter, 50-Ohm semi-rigid coaxial tubing (copper-jacket tubing)
3'	RG-316/U 50-Ohm coax cable
	RG-59/U 75-Ohm coax cable for downlead and connection to TV (under 3-dB loss per 100 feet at 63 MHz)
8	47-pF (or larger) NPO ceramic or porcelain chip caps (not critical; 18 pF will work) such as Union Carbide
1	18-pF NPO ceramic or porcelain chip cap such as Union Carbide
1	18-pF mica cap: Cornell-Dubilier CD10-CD180J03 or similar
1	24-pF mica cap: Cornell-Dubilier CD10-ED240J03 or similar
1	1.5-to-6.0-pF microminiature ceramic trimmer such as Erie* (range not critical; e.g., 2.0 to 10 pF would work)
14	0.01-uF miniature ceramic caps: Corning CACO3X7R103K or similar
7	4.7-uF, 35-V aluminum electrolytic cap
1	10-uF, 35-V aluminum electrolytic cap
1	2200-uF, 50-V aluminum electrolytic cap: Digi-Key 2200/50A or similar
1	1k linear potentiometer
	¼-Watt, 5% carbon composition resistors (film should work)
2	51-Ohm
2	120-Ohm
1	160-Ohm
1	180-Ohm
1	200-Ohm
2	360-Ohm
3	1k-Ohm
1	1.6k-Ohm
2	2.7k-Ohm
2	3k-Ohm
2	10k-Ohm
1	5.1k-Ohm
4	1N4002 or similar rectifier diodes or molded bridge
1	25-V power transformer: Radio Shack 273-1512 or similar (the converter draws 57 mA: a light-duty transformer could be used instead)
1	Power-supply cabinet: Radio Shack 270-252 or similar
1	7"×5"×2" diecast-aluminum case with flange lid: Bud CU-247

*Typical potentiometer: Bourns, part #3262W, hermetically-sealed microminiature potentiometer, 12-turn, 50k. This is a high-quality trimmer availble only from industrial suppliers. The unit cost is $9.22, but a similar inexpensive pot can be substituted. Substitutes should also be hermetically sealed, however.

effect, changing the bias changes the tuning. That's one reason why an on-board regulator is necessary. Unfortunately, an emitter resistor can't correctly be used with the input amplifier as was done with the local oscillator, so a different negative-feedback network which requires an initial adjustment was necessary.

Optimum performance won't be achieved if the bias conditions differ very much from the required V_{ce}=15 V and I_c=25 mA. To compensate for differences in dc beta between similar devices, the input amplifier's base resistor, R_B, should be chosen to provide this bias point accurately. Note: For both the input amplifier and local oscillator, be very careful to apply V_{cc}=20 V only after the bias network is complete because the open-base breakdown voltage, V_{ceo}, is 20 V; the transistor may be destroyed otherwise. With the base connected, BV_{ces}=30 V, minimum, so there is no danger if the network is complete.

Accurately measure all the input amplifier's bias resistors before they are soldered in so that I_c can be calculated from their operating voltage drops. Adjust base potentiometer R_B to approximately 10k after connecting its wiper to either end, and then solder its two ends into the board. Note that the photographed board used a fixed resistor for R_B; finding an accurate fixed value is a tedious process. During tune-up, power is applied (via the BNC connector) and R_B is adjusted to provided V_{ce}=15.0 V. I_c is then calculated from the bias network voltages and resistances.

It probably won't be possible to simultaneously achieve the required current and voltage exactly without varying R_{B1} as well as R_B, so a tradeoff is necessary; e.g., 15.2 V and 25.2 mA would be a better choice than 15.0 V and 25.6 mA. The input and output of the input amplifier are shunted to ground through quarter-wave bias stubs with a chip and tantalum capacitor. This acts as a shunt bandpass filter, shorting all lower frequencies.

Output Amplifier

This is a basic two-stage amplifier with three resonators to provide the desired overall bandpass response. Although MOSFETs have advantages over bipolar transistors, one precaution which must be observed has to do with susceptibility to static discharge. It would be a good idea to connect the MOSFETs last, working above a grounded benchtop. Once soldered in, the danger is over.

Tune-Up

After the converter has been built but before connecting any of the four transistors, the first step is to measure the output of the on-board regulator with an input of about 25 V; if it doesn't supply an accurate 20 V, adjust one or both of its resistors Until it does:

$$V_{cc} = 1.25[1 + (R_2/R_1)].$$

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Next, after the board is completed (with R_B preset) and mounted in the case with the connectors soldered, tune-up consists of adjusting R_B as already explained, adjusting the local-oscillator frequency with its trimmer capacitor (with the power supply set at midrange), and then peaking the three slug-tuned output-amplifier inductors, which provides a 6-MHz overall bandpass response. In actual use, with the output resonator loaded by a 75-Ohm television input instead of a 50-Ohm spectrum analyzer, the response would be broader.

The local-oscillator signal can be monitored at the converter output with either a spectrum analyzer or microwave frequency counter if either is available. If not, the transmitted signal should be usable for tune-up since the resonators don't peak sharply. Butterworth bandpass response would require different component values, and alignment equipment would be mandatory. For an input at 2.153 GHz and the output tuned to channel 3, centered at 63 MHz, the oscillator is tuned to 2.216 GHz. The voltage tuning range is broad enough to tune both the correct and image oscillator frequencies.

My antenna consists of a feedhorn placed at the focus of a parabolic dish. In a strong signal location, a dish isn't necessary; the feedhorn itself can be used as the antenna since the dish only increases the area over which the signal is collected. The feedhorn produces a microwave standing wave within itself so that the signal can be picked off with a quarter-wave dipole. For a given frequency, the dipole's optimum position in the feedhorn depends on the "guide wavelength," which depends on the radius of the circular waveguide used. I prefer to use other than coffee cans because of their ribs. I chose a can which was used to ship silicon wafers because the sides and end are very straight and smooth, more like a commercial waveguide section. This means cleaner internal reflections with no scattering.

For a feedhorn with a 2.0-inch radius operating at 2.153 GHz, the dipole is placed 5.8 cm from the closed end of the can (parallel to it). The dipole should be oriented vertically since that is the normal transmission polarization. There may be an adjacent channel with horizontal polarization. The quarter-wave dipole is made by soldering a piece of semi-rigid coaxial tubing to an appropriate SMA connector, removing the shield all the way to the connector, and then trimming the center conductor to 3.3 cm long. I use thin silver/teflon RG-316/U cable with an SMA connector on each end to connect the antenna to the converter. The input impedance was designed to be 50 Ohms; it should be possible to use other antenna systems, cable configurations, or preamplification stages if desired.

Summary

When I completed the project, I was entirely satisfied with this converter and felt I could recommend it to others without reservation. Unfortunately, I have since experienced one problem with the most recent set of ten HXTR-2102 transistors I purchased: Some input amplifier transistors have failed, even though they were operated at the manufacturer's recommended bias point. There have been no local oscillator failures, but these are operated at a lower power level. This seems to be a manufacturer's isolated lot problem, but I can't be certain since I no longer have access to the array of sophisticated equipment used during development. This problem may be augmented by the tantalum capacitor on the base of the input amplifier transistor, since this holds the transistor off for approximately 10 milliseconds; with no current being drawn, 20 V appears at the collector for this time. Although it doesn't strictly apply, this happens to equal the absolute maximum rating for V_{ceo}. As a precaution, one may want to remove this tantalum capacitor and run the on-board regulator at 19.1 V instead of 20.0 V by changing R1 from a 200-Ohm to a 210-Ohm, 1%-tolerance resistor. If no other changes are made, the input amplifier will then be slightly detuned by operating somewhere near 15 V and 20 mA, depending on the adjustment of R_B. One can always totally eliminate the input amplifier transistor by removing all the bias and tuning stubs from the input line with a razor blade and using a copper-foil short in place of the transistor; this would mean the loss of about 14 dB of gain and some sensitivity.

For a better understanding of this project's design, or for practical application in another project, copies of my design notes are available. They include explanations, test data, and all calculations, including Smith Charts, waveguide and microstrip calculations, and a table of microstrip transmission line impedances. I will send copies of these notes first-class postage-paid for $4.00. Many parts are available only from industrial suppliers and so are difficult to obtain. I intend to supply a set of parts; write to me for details. ■

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Get With the Program and Speed Up Your Code

Here's an opportunity to increase your code speed without QRM, QRN, or QSB!

As the son of two licensed amateur-radio operators, it was natural that I would find hamming an interesting hobby. The theory was no problem for me as I have always been interested in electronics, but the code did not come quite so easily. I practiced and practiced, and finally passed my Novice examination.

Soon after receiving my Novice license, I realized that upgrading was a must. The code requirement of thirteen words a minute seemed insurmountable. Because I am a high-school student, my time is somewhat limited and time devoted to code practice became less and less. Finally I decided to wait for the summer, when I could devote as much time as I wanted toward getting my General ticket.

The summer came, but I soon realized that I was not making any progress trying to increase my code speed by operating in the Novice bands, and as an Apple computer enthusiast, I decided to put my computer to work with a program to send random code.

After I completed this program, I modified it to show me what it sent and to check my copy for any errors. Back to the drawing board once again. The new program would send the code and then prompt for the letters, numbers, or symbols when it was finished sending whatever number of characters the user desired. I also added into the program a method of scoring the user for the number of correct and incorrect characters copied. The next problem that I faced was: If I missed a number of characters while I was practicing, I could not be sure which character was next in line when I was checking what I had copied. I overcame this by having the program show the user all of the characters on screen in the order sent.

When this program was completed I still wasn't satisfied. It was partly because I enjoyed working on it and I was sorry the effort was over; so I rewrote the program with several enhancements. First I made it menu driven. The user can select the mode of practice he wants to take, the speed, and the tone, all from a series of menus.

Other enhancements included a drill that shows on the screen the character sent less than a second after the code sound is sent. This gives the user enough time to recognize the character in his mind, but not enough time to think about it or break down the character in his mind.

The new version of the program was just about complete when I decided there was one more modification it needed. I made the program keep the speed that the character is sent at 15 wpm and varied only the time between characters. The menu allows you to select the code speed you wish to copy, but only the space between characters changes, not the speed of the code itself. This results in a program that makes it easier for you to increase your speed because you are already used to the pattern of faster code. This method also makes taking the code apart in your mind almost impossible; you learn to recognize the characters only by their sound.

This program is written completely in Applesoft Basic and will work on the Apple II+ or IIe. It uses two machine-language subroutines that are POKEd into memory when the program is run. These routines are at location $300 and perform two needed functions that can be used in your own programs.

The first of these routines generates the tones. If you run this program and then exit it, the routines will be in memory. You can BSAVE them for your own use. To use the tone routine, POKE the pitch into location $0 and the duration of the note into location $1; then CALL 768 will play the desired note.

The second of these routines is used to scramble the random-number generator. This is done by scanning the keyboard and choosing a random number. If a key is pressed, then it continues, and if not, it does it again and again. This means that while waiting for a keypress, the program is scrambling the random numbers that will be used. This is needed because when the disk is first BOOTed, the random-number generator is given a seed number. The routine just steps through these to make them "more random."

To begin, run the program. A menu will appear on the screen and ask for your choice. The choices displayed are, first, practice drill, which is a drill that is scored and will prompt for the number of characters

you desire to receive. The second option is the visual drill. This drill shows the character sent on the screen just after it was sent. The third option on the menu is to change the tone. Enter a number from one to 255. The fourth option is the speed control and gives a sub-menu with your choice of speeds. The last option on the menu is to exit the program to Basic. Any key pressed other than those indicated will be ignored. When you use the first drill, the speed remains unchanged. This is not the case with the second drill. The second drill, when exited, will reset the speed back to 15 wpm. When the program is run, all speeds are set to 15 wpm until changed.

This program, as well as your Apple itself, can be greatly enhanced by adding a simple and inexpensive modification. The Apple is a remarkable piece of hardware, but there is a flaw. The audio of the Apple is not up to par. Part of this is due to the small size of the speaker. With the following simple modification, you can give your Apple a very loud voice.

An audio output transformer is required, such as Radio Shack part number 273-1380. The primary of the transformer (blue and green leads) is connected via a length of shielded cable to the auxilary input of any amplifier. The secondary (red and white leads) is connected to the speaker of the Apple. The best way to do this is to splice into the wires of the speaker. The speaker of the Apple is located face down on the left side of the Apple near the keyboard.

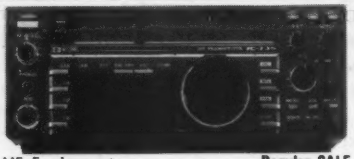
When this modification is made, the center tap of the primary of the transformer (black lead) should be cut off; it is not needed. The audio of the Apple will work normally but also will be fed through your amplifier. I use the amplifier in my color monitor. This simple modification will make this code program more useful and will enhance any Apple application using sound.

This program has helped me and I hope that it will help you, too. The modification can be made with only a small investment in a transformer and some cable. This program will operate without it, but by enhancing the sound of the computer, the program sounds better. Due to the excessive length of this program, I will supply it on a DOS 3.3 disk upon receipt of a check for $10.00 and a self-addressed mailing label.

Here is your opportunity to increase your code speed with no QRM, QRN, or QSB, and at your own convenience. Enjoy!■

Program listing.

```
10  RESTORE
20 P = 100: POKE 0,P
30 SP = 30
40  DIM A$(39),C$(39),Q$(1000)
50  DATA     173,48,192,136,208,4,198,1,240,8,202,208,246,166,0,76,0,3,96
60  DATA      141,16,192,32 ,174,239,173,00,192,201,128,144,246,96
70  DATA  01,A,1000,B,1010,C,100,D,0,E,0010,F,110,G,0000,H,00,I,0111,J,10
    1,K,0100,L,11,M,10,N,111,O,0110,P,1101,Q,010,R,000,S,1,T,001,U,0001,
    V,011,W,1001,X,1011,Y,1100,Z
80  DATA  01111,1,00111,2,00011,3,00001,4,00000,5,10000,6,11000,7,11100,8
    ,11110,9,11111,0,010101,.,001100,?
90  DATA   110011,","
100  FOR I = 768 TO 800: READ X: POKE I,X: NEXT
110  FOR I = 1 TO 39: READ C$(I): READ A$(I): NEXT
120  TEXT : HOME : VTAB 11: PRINT  TAB( 8);"PRESS ANY KEY TO START"
130  CALL 787
140  GET A$
150  TEXT : HOME
160 C = 0:W = 0
165  HOME
170  INVERSE : FOR I = 1 TO 39: PRINT " ";: NEXT : PRINT : NORMAL : PRINT
     "  MORSE CODE PRACTICE PROGRAM      V1.1": FOR I = 1 TO 39: PRINT "-"
     ;: NEXT : PRINT " ";: INVERSE : FOR I = 1 TO 39: PRINT " ";: NEXT
180  NORMAL
190  PRINT : PRINT : PRINT  TAB( 17);"OPTIONS": PRINT : PRINT
200  PRINT "<1>. PRACTICE DRILL"
210  PRINT
220  PRINT "<2>. VISUAL DRILL"
230  PRINT
240  PRINT "<3>. SET TONE"
250  PRINT
260  PRINT "<4>. SET SPEED"
270  PRINT
280  PRINT "<5>. EXIT TO BASIC"
290  VTAB 22: PRINT "ENTER THE NUMBER OF YOUR CHOICE";: GET A$:A =  VAL (
     A$): IF A < 1 OR A > 5 THEN 165
295  HOME
300  IF A = 5 THEN  HOME : END
310  IF A = 4 THEN 920
320  IF A < 3 THEN 360
330  HOME : PRINT : PRINT
340  PRINT "ENTER THE PITCH (100 IS NORMAL)";: INPUT P$:P =  VAL (P$): IF
     P < 0 OR P > 255 THEN 330
350  POKE 0,P: GOTO 150
360  IF A = 1 THEN 500
370  HOME : PRINT "PRESS >>>RESET<<< TO EXIT THIS MODE"
380  POKE 34,1
390  POKE 1010,102: POKE 1011,213: POKE 1012,112
400 R =  INT ( RND (1) * 39) + 1
410 L =  LEN (C$(R))
420  FOR I = 1 TO L
430 S$ =  MID$ (C$(R),I,1)
440  IF S$ = "0" THEN  GOSUB 870
450  IF S$ = "1" THEN  GOSUB 890
460  NEXT I
470  GOSUB 910
480  VTAB 11: HTAB 19: PRINT A$(R)
490  FOR Z = 1 TO 90: NEXT Z: GOTO 400
500  REM  DRILL
510  HOME : PRINT : INPUT "HOW MANY CHARACTERS";CH
520  HOME : PRINT "   GET READY TO COPY CODE"
530  FOR Z = 10 TO 0 STEP  - 1
540  VTAB 11: PRINT  TAB( 19);Z
550  FOR DD = 1 TO 500: NEXT DD
560  IF Z = 10 THEN  VTAB 11: PRINT  TAB( 19);"  "
570  NEXT Z
580  HOME
590  FOR ZZ = 1 TO CH
600 R =  INT ( RND (1) * 39) + 1
610 L =  LEN (C$(R))
620  FOR S = 1 TO L
630 S$ =  MID$ (C$(R),S,1)
640  IF S$ = "0" THEN  GOSUB 870
650  IF S$ = "1" THEN  GOSUB 890
660  NEXT S: GOSUB 910:Q$(ZZ) = A$(R)
670  NEXT ZZ
680  REM  SCORE
690  HOME
700  FOR Z = 1 TO CH
710  PRINT "ENTER CHARACTER # ";Z;
720  GET U$: IF U$ = Q$(Z) THEN  PRINT " CORRECT":C = C + 1
730  IF U$ <  > Q$(Z) THEN  PRINT " INCORRECT    ";Q$(Z):W = W + 1
740  NEXT Z
750  PRINT : PRINT : PRINT "HIT ANY KEY TO CONTINUE";: GET U$: HOME
760  PRINT  TAB( 17);"ANSWERS"
770  POKE 34,1
780  PRINT
790  FOR I = 1 TO CH STEP 3
800  PRINT Q$(I),Q$(I + 1),Q$(I + 2)
810 G = G + 1: IF G = 10 THEN  PRINT "HIT ANY KEY TO CONTINUE";: GET G$:G
     = 0
820  PRINT
830  NEXT I
840  PRINT : PRINT " CORRECT ";C;"       INCORRECT ";W
850  PRINT : VTAB 23: PRINT "HIT ANY KEY TO RETURN TO THE MAIN MENU";: GET
     U$: GOTO 150
860  END
870  POKE 1,30: CALL 768: FOR Z = 1 TO 10: NEXT
880  RETURN
890  POKE 1,90: CALL 768: FOR Z = 1 TO 10: NEXT
900  RETURN
910  FOR Z = 1 TO SP: NEXT : RETURN
920  REM  MENU
930  HOME : PRINT "ENTER SPEED"
940  PRINT "-----------"
950  PRINT : PRINT
960  PRINT "<1>. 3 W.P.M."
970  PRINT
980  PRINT "<2>. 4 W.P.M."
990  PRINT
1000  PRINT "<3>. 5 W.P.M."
1010  PRINT
1020  PRINT "<4>. 7 W.P.M."
1030  PRINT
1040  PRINT "<5>. 9 W.P.M."
1050  PRINT
1060  PRINT "<6>. 10 W.P.M."
1070  PRINT
1080  PRINT "<7>. 13 W.P.M."
1090  PRINT
1100  PRINT "<8>. 15 W.P.M."
1110  VTAB 22: PRINT "ENTER THE NUMBER OF YOUR CHOICE";: GET A$:A =  VAL
     (A$)
1120  IF A < 1 OR A > 8 THEN 920
1130  IF A = 1 THEN SP = 3500
1140  IF A = 2 THEN SP = 2500
1150  IF A = 3 THEN SP = 1970
1160  IF A = 4 THEN SP = 1000
1170  IF A = 5 THEN SP = 700
1180  IF A = 6 THEN SP = 500
1190  IF A = 7 THEN SP = 200
1200  IF A = 8 THEN SP = 100
1210  GOTO 150
```



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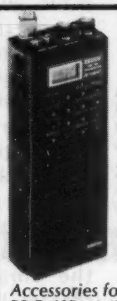

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The Potabilities Are Endless

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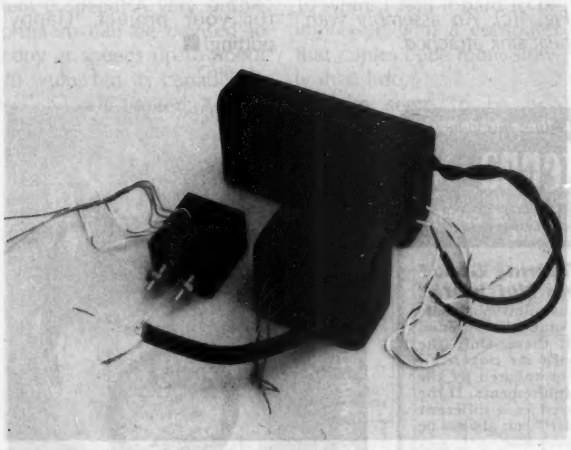

Photo A. Some examples of potting.

Have you ever had a circuit that you wished could be weather-proofed or ruggedized for severe vibration or other environmental effects?

Potting, or plastic encapsulation, could be the answer. Virtually any circuit can be encapsulated if it meets a few basic requirements. Number one, it should be completely tested to be sure it will operate satisfactorily—black cubes are hard to troubleshoot! Two, no adjustable components will be accessible once potted, so they cannot be included within the module. Connecting leads can be brought out, however, and variable components can be mounted externally. The third and last requirement is that the package should be relatively inexpensive. If something goes wrong, you're looking at a throwaway item unless you're into dissolving the potting compound.

The secret potting compound? It's available at any auto supply store; it's automotive body filler! Sold under many different brands, it's a polyester resin with styrene monomers added. A hardener is added to the mixture, and the substance

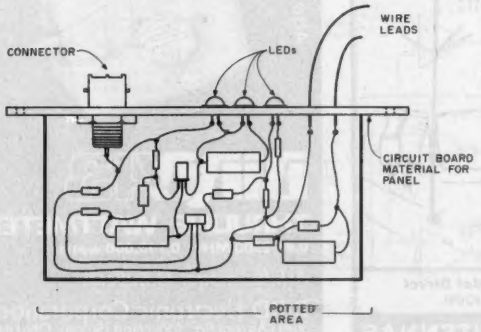

Fig. 1(a). A potted assembly which includes a panel for connectors and indicators.

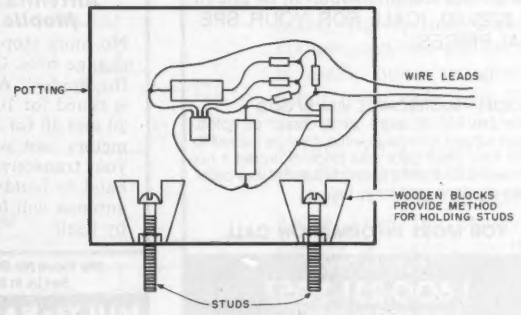

Fig. 1(b). A potted assembly with mounting studs which extend through the mold during curing.

cures in about 30 minutes. (Follow the directions on the container.) I have tested a number of different brands and all seem to have excellent mechanical properties and good dielectric strength. A 15-kV power supply potted over a year ago has functioned perfectly with no indication of insulation breakdown.

Making modules is easy; you can "hay-wire" the interior electronics together, saving on mechanical supports, sockets, and hardware. Make sure, however, that all solder connections are good and that nothing will short together during potting; don't forget to test!

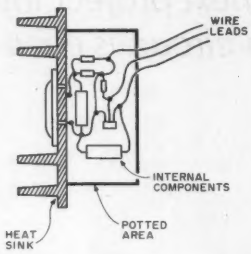

Fig. 1(c). An assembly with heat sink attached.

You will need some type of mold to hold the potting material while it is curing. I have used ice-cube trays, tin cans, small cardboard boxes, and plastic cases. Some can be break-away and others can be reused. Make sure the sides of the mold are coated with clear silicone grease to make extraction easier.

Figs. 1(a), 1(b), and 1(c) give some additional hints you can use for your modules. If you goof, remember that before the module has its final inspection, it can be filed, sanded, and painted. Any voids can be repaired with a second pour of additional material. A completed module can really look professional. Your friends will be asking where you bought that "special part" for your project. Happy potting! ■

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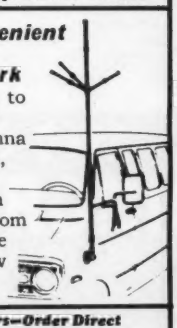

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David Oliver W9ODK
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The Basics of Computer CW

Here's a twist: W9ODK preprocesses Morse to make life easier for his VIC-20. The result? A Basic program that copies code from 5 to 50 words per minute.

Anyone who has tried to write a Basic program to receive Morse code knows that the primary problem is speed. A very simple program can be devised to copy at speeds up to about 30 wpm, but its capabilities are severely limited. Adding such niceties as automatic speed tracking and some rudimentary error checking results in a top speed of only 10 wpm. I find it hard to be impressed with a computer that copies code more slowly than I do.

There seem to be two ways around this problem. Write the program in machine language (not easy with the VIC-20 and an alien language to most casual programmers) or devise a smart interface to go with a dumb program. The latter choice is a departure from conventional thinking regarding computers, i.e., using the "intelligence" of the machine to its maximum capability. This article describes an interface which makes all of the decisions concerning speed, length of character elements, and spacing between characters and words. The computer is required only to decide which character has been sent and then display it on the screen. This combination is self-adjusting for speeds from 5 to 50 wpm (top speed still limited by the Basic interpreter), is very accurate even under difficult conditions, and is very easy to use. It appears to perform as well as any hardware/software combination now available.

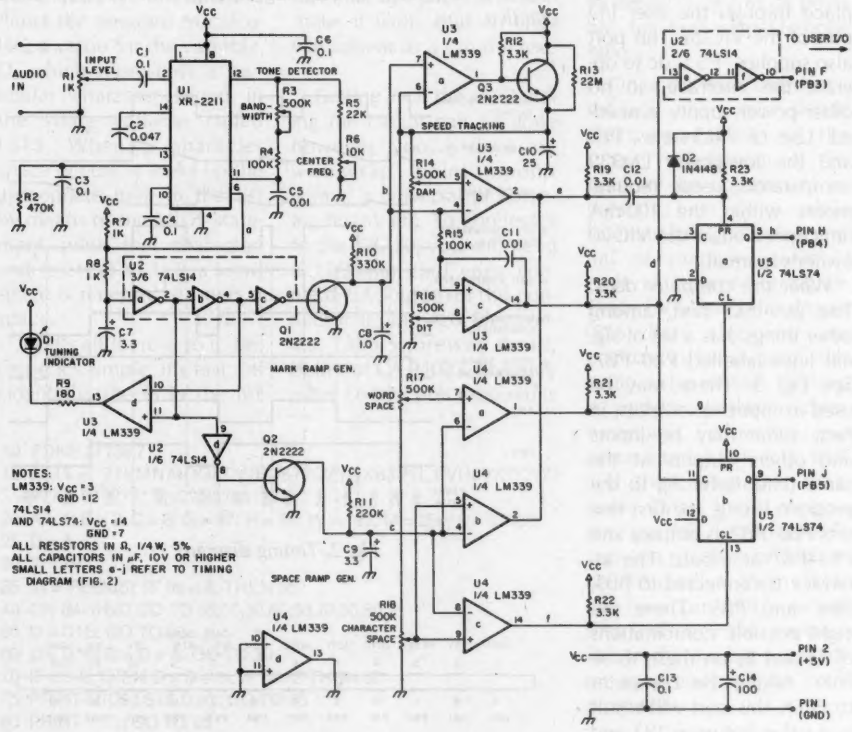

Fig. 1. Schematic diagram.

At first look, the schematic, Fig. 1, may appear complicated, but the circuit is really quite straightforward, using only five ICs, and it is easy to build and adjust. Total parts cost should be under $15.00.

Here is how it works: Audio from the receiver speaker is applied to the XR-2211 phase-locked-loop demodulator, here used as a tone decoder. Using the external components specified, it can be tuned from

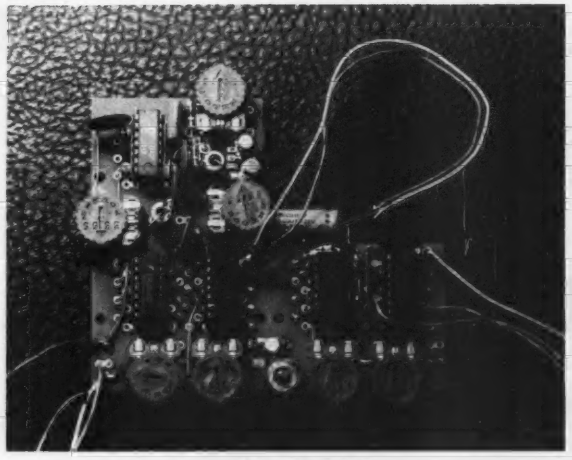

Photo A. The completed circuit board.

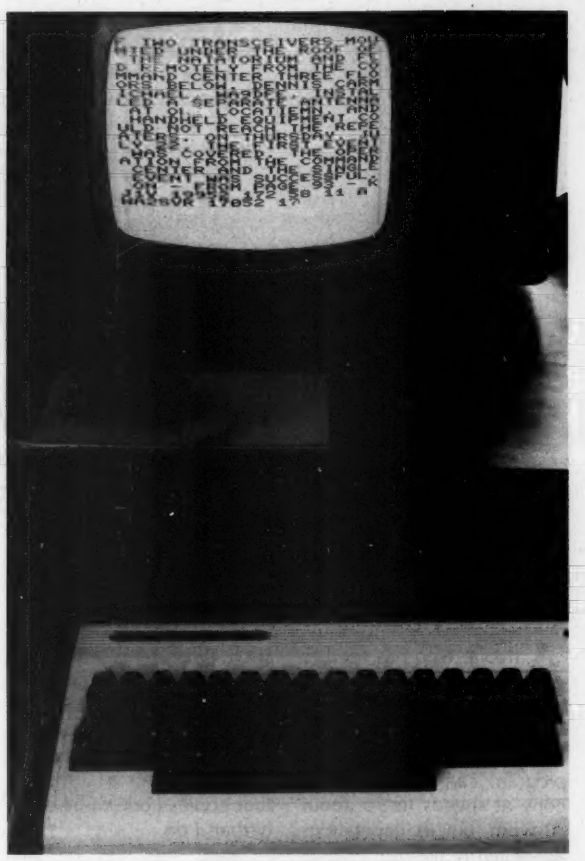

Photo B. Interface undergoing testing with W1AW code practice.

650 to 950 Hz and the bandwidth can be varied from 400 Hz down to about 70 Hz. The output from pin 6 is high when a tone is present. To prevent problems from noise spikes, the output of the 2211 is processed through an RC network (R8, C7) and several sections of a Schmitt-trigger inverter (U2).

Two separate voltage ramps are generated representing key down (mark) and key up (space). Refer to the timing diagram, Fig. 2. At slower speeds the ramps will rise to higher voltages, the rate of rise determined by RC networks R10-C8 and R11-C9. A peak-sensing circuit consisting of U3a, Q3, and C10 holds the highest level reached by the mark ramp generator. This becomes the reference by which character elements (dits and dahs) and spaces are determined. The speed reference voltage is established so quickly that only one letter need be sent before accurate copy begins. In fact, if the first letter starts with a dah, it will probably be displayed correctly.

A group of comparators, U3b–U4c, analyzes the two ramps to determine when a dit, a dah, a character space, or a word space has occurred. The outputs of the comparators control U5, a dual D-type flip-flop. There are four possible combinations of high and low levels from the Q outputs of the two flip-flops representing the above four events. Confusion could occur if there are two or more dits or dahs in a row, so a third signal line to the computer is needed. The output of the dit comparator, U3c, acts somewhat like a clock, telling the computer that a change has occurred.

Communication takes place through the user I/O port of the VIC-20. This port also supplies +5 V dc to operate the interface, so no other power supply is needed. Use of 74LS-series TTL and the low-power LM339 comparators keeps requirements within the 100-mA limit specified in the VIC-20 owner's manual.

What the computer does: The user I/O port, among other things, has a set of signal lines labelled PB0–PB7. See Fig. 3. These may be used as inputs or outputs; in fact, some may be inputs and others outputs at the same time. Referring to the program listing, the first line sets PB0–PB2 as outputs and PB3–PB7 as inputs. The interface is connected to PB3, PB4, and PB5. There are eight possible combinations of 1s and 0s on these three lines. Asking the computer to PEEK this port will result in a value between 192 and 248 in steps of 8. Four of

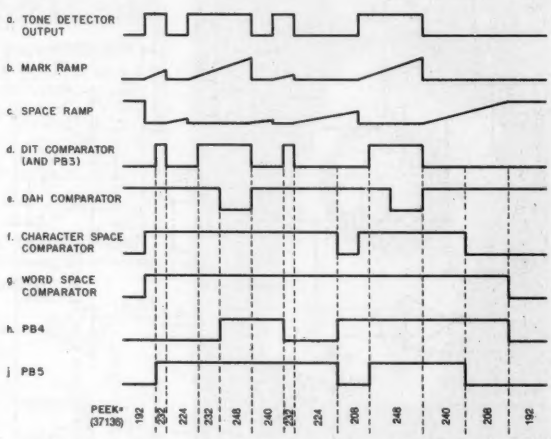

Fig. 2. Timing diagram.

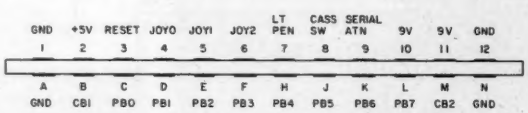
GND +5V RESET JOY0 JOY1 JOY2 LT PEN CASS SW SERIAL ATN 9V 9V GND
1 2 3 4 5 6 7 8 9 10 11 12
A B C D E F H J K L M N
GND CB1 PB0 PB1 PB2 PB3 PB4 PB5 PB6 PB7 CB2 GND

Fig. 3. VIC-20 user I/O port.

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these states are relevant and direct the program to calculate a value for the variable, D, which represents a particular character found in the string variable called LST$. When a character space occurs, it looks up the appropriate item in the list by means of the MID$ statement, prints that character, and resets D to 1. If a word space is received, it prints a space.

That's all there is to it. Because it's simple, it's fast. Incidentally, the ?s in the list just take up spaces and also make it likely that an error will appear as a ? in the text.

Getting it on the air: Building the circuit can be done however you wish using wire-wrap, point-to-point wiring, a universal prototyping board, etc. To connect it to the VIC-20, you will need a 12/24-pin card edge connector. A source for this connector is: Jameco Electronics, 1355 Shoreway Road, Belmont CA 94002. The only other connection required is to the speaker output of the receiver or transceiver.

```
10 POKE 37138,7
15 LST$ = "?TEMNAIOGKDWRUS??QZYCXBJP?L,FVH09?8????7
   #???/-61????*?@2?.?3?45????"
20 A = 1: B = 2: C = 8: G = 67: H = 48: IN = 192: M = 256: S = 37136
25 D = A
30 IL = IN
35 IN = PEEK(S): IF IN = IL THEN 35
40 ON (M-IN)/C GO TO 30,50,30,60,30,70,30,80
50 D = D*B: GO TO 30
60 D = D*B: D = D + A: GO TO 30
70 IF D>G THEN D = D - H: IF D>G THEN 80
75 PRINT MID$(LST$,D,A);: GO TO 25
80 PRINT " ";: GO TO 25
```

Program listing.

Adjustment is not at all critical. Start out with all the pots at half rotation. Connect the sidetone from an electronic keyer, CW keyboard, or some other source of accurately-spaced Morse characters to audio in. You may want to start copying code right off the air, in which case W1AW code practice is an ideal source. Higher speeds are more critical, so the 35-wpm practice is best for setup.

Begin by adjusting the tone detector. With the receiver tuned to match the transmitter sidetone frequency or whatever pitch you normally use for CW, adjust R6 so that the LED tuning indicator (D1) flashes in sync with the code being received. With the receiver volume at normal listening level, turn R1 down until the LED goes out, then advance it just until the light responds to the CW signal and not background noise. It is important to keep the input to the 2211 as low as possible for best signal-to-noise ratio.

Once the tone detector is set up, characters should start appearing on the screen. Adjustment of the pots on the comparator inputs is best done while listening to a good clean signal of machine-generated code at 30 wpm or higher. Begin by turning the dit pot (R16) both clockwise and counterclockwise until dits begin to be missed, then set it midway between these two points. Follow the same procedure for R14, R17, R18, and their respective functions. Once these controls are set for 100% reliable copy on machine-sent code, do not readjust them. Probably you can find a setting that will copy the sloppiest fist on the air, but accuracy on good code will be compromised.

The only pot you might want as a front-panel control is R3, the bandwidth adjustment. It could be set at maximum bandwidth (minimum resistance) for easy tuning and changed to a narrower passband for heavy QRM. The phase-locked loop in the XR-2211 does a good job of rejecting signals out of its lock range. An interfering signal can simply be tuned off the edge of the passband by adjusting the receiver tuning dial or transceiver RIT. A bandpass filter was tried in the audio input line but didn't seem to be necessary.

Where to go from here: The POKE statement in the program leaves PB0–PB2 as outputs. There is a reason for this, namely to allow one of these lines to key the transmitter when a sending segment is added to the program, thereby making the VIC-20 a complete CW terminal. Two *73* articles should start you on your way to developing this program: "Apple, Morse, and You," AF2M, July, 1983; and "VisiCode: The VIC-20 Way to Extra Class," W7LTH and KA7AQA, August, 1983.

This interface and program will work equally well for the Commodore 64. For the C-64 change line 10 to 10 POKE 56579,7. In line 20, change S=37136 to S=56577.

If you would like a cassette copy of a complete CW send-and-receive program for the VIC-20 or C-64 which features message buffers and random code practice with variable speed and character spacing, send $6.00 to the author (this includes postage). Be sure to specify which computer you have.

Computers are rapidly becoming a part of the ham shack, and the easiest place for you to start is with a CW interface. Combining the oldest form of electronic communication with the latest in technology lends continuity to the ever-changing hobby of amateur radio. ■

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Program listing.

```
10 REM                          ******************
20 REM                          **  BASTTY.BAS  **
30 REM                          ******************
40 :
50 REM ************** Teletype Program, writ by R. E. Levin ***********
60 REM ***************     for H-89, with HDOS and MBASIC      ***********
70 REM ***************        May 1983.  Austin Texas          ***********
80 REM ***************                (W3RWU)                  ***********
90 :
100 CLEAR 2000
110 DIM L(32),F(32),L1(96)
120 E$=CHR$(27)
130 PRINT E$+"y1";M=38200!
140 PRINT E$+"E"
150 CF=2
160 OUT 220,0:REM *** TOGGLES DTR PORT FOR TRANSCEIVER PTT ***********
170 PRINT:PRINT:PRINT"SELECT MODE-SPEED:"
180 PRINT "-----------------"
190 PRINT:PRINT"BAUDOT:"
200 PRINT"--------"
210 PRINT:PRINT"1. 60 WPM"
220 PRINT"2. 66 WPM"
230 PRINT"3. 75 WPM"
240 PRINT"4. 100 WPM"
250 PRINT:PRINT"ASCII:"
260 PRINT"------"
270 PRINT:PRINT"5. 110 BAUD"
280 PRINT"6. 300 BAUD"
290 PRINT:PRINT:PRINT:PRINT:INPUT " SELECT NUMBER ";S
300 IF S>=5 THEN FL=0 ELSE FL=1
310 ON S GOTO 320,330,340,350,360,370
320 A=199:B=9:C=4:GOTO 390
330 A=227:B=8:C=4:GOTO 390
340 A=210:B=7:C=4:GOTO 390
350 A=222:B=5:C=4:GOTO 390
360 A=23:B=4:C=7:GOTO 390
370 A=128:B=1:C=3
380 REM    ****** INITIALIZE SERIAL I/O ACE (8250) ********
390 OUT 242,2:OUT 219,128:OUT 216,A:OUT217,B:OUT219,C:OUT217,0
400 REM    ****** INITIALIZE PRINTER ACE (4800 BAUD) **************
410 OUT 227,128:OUT 224,24:OUT 225,0:OUT 227,3:OUT 225,0
420 REM    ********** SET H-14 PRINTER TO 96 CHARAC./LINE **********
430 OUT 224,27:OUT 224,117:OUT 224,20
440 IF FL=0 THEN 510
450 RESTORE 3190
460 FOR I=0 TO 31:READ L(I): NEXT
470 FOR I=0 TO 31:READ F(I): NEXT
480 FOR I=0 TO 96:READ L1(I): NEXT
490 GOTO 510
500 PRINT E$+"E";:PRINT E$+"x5";
510 PRINT E$+"x5";
520 DEF FN Y$(X)=E$+"Y"+CHR$(31+X)+CHR$(62)
530 X=2
540 PRINT FN Y$(X);"SELECT FUNCTION:":X=X+1
550 PRINT FN Y$(X);"-----------------":X=X+1
560 X=X+2
570 PRINT FN Y$(X);" 1. RECEIVE (CTRL R during trans.)":X=X+1
580 PRINT FN Y$(X);" 2. SEND Kybd' (CTRL T during REC.)":X=X+1
590 PRINT FN Y$(X);" 3. RY Test (^U in ASCII)":X=X+1
600 PRINT FN Y$(X);" 4. CB Msg.":X=X+1
610 PRINT FN Y$(X);" 5. CW IDentification (CTRL I)":X=X+1
620 PRINT FN Y$(X);" 6. Transmit a FILE.EXT from disk":X=X+1
630 PRINT FN Y$(X);" 7. Read buffer":X=X+1
640 PRINT FN Y$(X);" 8. Erase buffer":X=X+1
650 PRINT FN Y$(X);" 9. Write buffer to DISK":X=X+1
660 PRINT FN Y$(X);"10. Transmit canned message":X=X+1
670 PRINT FN Y$(X);"11. Return to main MENU (CTRL D)":X=X+2
680 PRINT FN Y$(X);"    (To put receiving msg. in buffer":X=X+1
690 PRINT FN Y$(X);"     use CTRL K)"
700 X=X+4
710 PRINT E$+"y5";
720 PRINT FN Y$(X);:INPUT"SELECT NO. ";N
730 ON N GOTO 740,1210,1840,2060,2260,1650,2690,2580,2430,2840,140
740 REM ********************** ASCII REC ROUTINE *****************
750 IF FL=1 THEN 920
760 OUT 220,0
770 PRINT:PRINT
780 K=INP(221)AND 1
790 IF INP(232)=20 THEN GOSUB 2590:GOTO 1210
800 IF INP(232)=4 THEN GOSUB 2590:GOTO 500
810 IF K=0 THEN 780
820 C=INP(216)AND 127
830 IF C=12 THEN 780
840 IF C=27 THEN 780
850 IF C>127 THEN 780
860 PRINT CHR$(C);
870 OUT 224,C
880 IF INP(232)<>11 THEN 780
890 POKE M,C:M=M+1:POKE M,255
900 IF M=56000! THEN M=38200!
910 GOTO 780
920 REM ************ BAUDOT REC ROUTINE ****************
930 OUT 220,0
940 PRINT:PRINT
950 K=INP(221) AND 1
960 IF INP(232)=4 THEN GOSUB 2590:GOTO 500
970 IF INP(232)=20 THEN GOSUB 2590:GOTO 1210
980 IF K=0 THEN 950
990 A=INP(216) AND 31
1000 IF A=27 THEN 1080
1010 C=L(A)
1020 PRINT CHR$(C);
1030 OUT 224,C
1040 IF INP(232)<>11 THEN 950
1050 POKE M,C:M=M+1:POKE M,255
1060 IF M=56000! THEN M=38200!
1070 GOTO 950
1080 K=INP(221)AND 1
1090 IF INP(232)=4 THEN GOSUB 2590:GOTO 500
1100 IF INP(232)=20 THEN GOSUB 2590:GOTO 1210
1110 IF K=0 THEN 1080
1120 A=INP(216)AND 31
1130 IF A=31 THEN 950
1140 C=F(A)
1150 PRINT CHR$(C);
1160 OUT 224,C
1170 IF INP(232)<>11 THEN 1080
1180 POKE M,C:M=M+1:POKE M,255
1190 IF M=56000! THEN M=38200!
1200 GOTO 1080
1210 PRINT:PRINT:REM ************** KEYBOARD TRANS ROUTINE *****************
1220 OUT 220,1
1230 GOSUB 3030
1240 P=ASC(INPUT$(1))
1250 IF P=9 THEN 2260
1260 IF P=27 THEN 1240
1270 IF P=4 THEN 500
1280 IF P=18 THEN 1290 ELSE 1300
1290 IF FL=0 THEN 740 ELSE 920
1300 PRINT CHR$(P);:OUT 224,P
1310 IF P=13 THEN OUT 224,10:PRINT
1320 IF FL=1 THEN L=P:GOSUB 1380 ELSE 1340
1330 GOTO 1240
1340 GOSUB 1580
1350 IF P=13 THEN P=10:GOSUB 1580
1360 GOTO 1240
1370 REM *************** BAUDOT SEND SUB-ROUTINE ***************
1380 IF L>=97 THEN L=L-32
1390 IF L=32 THEN 1530
1400 IF L=9 THEN 1540
1410 IF L=13 THEN 1570
1420 IF L>=65 THEN 1480
1430 IF CF=2 THEN 1470
1440 P=L1(L):GOSUB 1580
1450 CF=1
1460 RETURN
1470 P=27:GOSUB 1580:GOTO 1440
1480 IF CF=1 THEN 1520
1490 P=L1(L):GOSUB 1580
1500 CF=2
1510 RETURN
1520 P=31:GOSUB 1580:GOTO 1490
1530 IF CF=2 THEN 1550
1540 P=31:GOSUB 1580
1550 P=4 :GOSUB 1580
1560 GOTO 1500
1570 P=31:GOSUB 1580:P=8:GOSUB 1580:P=2:GOSUB 1580:GOTO 1500
1580 REM ****************** CHARACTER OUT SUB-ROUTINE *************
1590 X=INP(221)AND 32
1600 IF INP(232)=4 THEN CLOSE:GOTO 500
1610 IF X=0 THEN 1590
1620 P=P AND 127
1630 OUT 216,P
1640 RETURN
1650 REM ************ TRANSMIT A FILE FROM DISK ****************
1660 PRINT:PRINT:PRINT
1670 INPUT "                              FILE NAME ";N$
```

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After writing and using a Teletype® (TTY) program in assembly language, I was curious to see if MBasic, with its speed restrictions, would be able to do the same thing. This program is the satisfactory result of that quest. The program, operating at selected speeds from 60-wpm Baudot to 300-baud ASCII, will receive and transmit from the keyboard, write to or transmit from a disk file, send a canned message, provide a hard copy of received and sent traffic, and store received messages in a memory buffer.

Heath provided, with the 88-3 serial interface board, a simple way to interface a teletype terminal unit (TU) and other input/output (I/O) control functions. At the rear connector, P2, the TU is connected to pin 2 for data out and pin 3 for data in. Pin 20, the Modem Control Register, is used in this program to control the push-to-talk (PTT) of a transceiver. The first bit (bit 0) of port 220 (decimal), the Data Terminal Ready (DTR), is used for this purpose. The RS-232 levels of this port are used to control an optoisolator which in turn triggers a heavy-duty NPN transistor to key the transceivers, providing complete isolation of the H-89 computer from the "outside world." All RTTY control (except tuning) is done from the keyboard.

The Program

Line 390 initializes the Asynchronous Communications Element (ACE) for the desired baud rate and bit configuration as selected from lines 170–370 of the first menu. The H-14 printer is set up in lines 410–430. If hard copy is desired of either received or transmitted data, merely turn the printer on. Make sure the printer is on when you start

```
1680 OUT 220,1
1690 GOSUB 3030
1700 OPEN "I",#1,N$
1710 A$=INPUT$(1,#1)
1720 P=ASC(A$)
1730 P=P AND 127:L=P
1740 IF P<>13 THEN 1770
1750 IF FL=1 THEN P=8:GOSUB 1580:P=2:GOSUB 1580:PRINT:GOTO 1710
1760 GOSUB 1580:P=10:GOSUB 1580:PRINT:GOTO 1710
1770 PRINT A$;
1780 IF FL=1 THEN GOSUB 1380:GOTO 1800
1790 GOSUB 1580
1800 IF EOF(1) THEN 1820
1810 GOTO 1710
1820 PRINT:PRINT:PRINT:CLOSE
1830 GOTO 1210
1840 PRINT:PRINT:REM ************** RY (*U in ASCII) TEST  **********
1850 OUT 220,1
1860 GOSUB 3030
1870 IF FL=1 THEN 1920
1880 FOR I=1 TO 25
1890 P=42:PRINT CHR$(P);:GOSUB 1580
1900 P=85:PRINT CHR$(P);:GOSUB 1580
1910 NEXT I:GOTO 1960
1920 FOR I=1 TO 25
1930 L=82:PRINT CHR$(L);:GOSUB 1380
1940 L=89:PRINT CHR$(L);:GOSUB 1380
1950 NEXT I
1960 RESTORE 3330
1970 FOR I=1 TO 12
1980 READ P:L=P:PRINT CHR$(P);:IF FL=1 THEN GOSUB 1380 ELSE GOSUB 1580
1990 NEXT I
2000 PRINT
2010 IF FL=0 THEN P=10:GOSUB 1580
2020 IF INP(232)=20 THEN 1210
2030 IF INP(232)=4 THEN 500
2040 IF INP(232)=9 THEN 2260
2050 IF FL=1 THEN 1920 ELSE 1880
2060 PRINT:PRINT:REM ****************** CQ MESSAGE ******************
2070 OUT 220,1
2080 GOSUB 3030
2090 FOR I=1 TO 15
2100 P=67:PRINT CHR$(P);:GOSUB 2240
2110 P=81:PRINT CHR$(P);:GOSUB 2240
2120 P=32:PRINT CHR$(P);:GOSUB 2240
2130 NEXT I
2140 RESTORE 3330
2150 FOR I=1 TO 12
2160 READ P:PRINT CHR$(P);:GOSUB 2240
2170 NEXT I
2180 PRINT
2190 IF FL=1 THEN P=2 ELSE P=10:GOSUB 1580
2200 IF INP(232)=4 THEN 500
2210 IF INP(232)=9 THEN 2260
2220 IF INP(232)=20 THEN 1210
2230 GOTO 2090
2240 IF FL=1 THEN L=P:GOSUB 1380:RETURN
2250 GOSUB 1580:RETURN
2260 REM ********** CW ID SUBROUTINE ***********
2270 OUT 220,1
2280 GOSUB 3030
2290 RESTORE 3280
2300 B=INP(219)
2310 PRINT E$+"p"
2320 PRINT"   CW ID'ing   ";
2330 READ C
2340 OUT 219,C
2350 IF C<>1 THEN 2410
2360 PRINT E$+"q";
2370 PRINT E$+"1"
2380 OUT 219,B
2390 IF FL=0 THEN 740
2400 GOTO 920
2410 FOR I=1 TO 25:NEXT
2420 GOTO 2330
2430 REM ******************** WRITE BUFFER TO DISK ROUTINE ******************
2440 OUT 220,0
2450 IF M<=38200! THEN 3070
2460 PRINT:PRINT
2470 INPUT "Give the file a name and .EXT ";N$
2480 OPEN "O",#1,"SY0:"+N$
2490 M=38200!
2500 Q=PEEK(M)
2510 IF Q=255 THEN 2560
2520 IF Q=13 THEN 2540
2530 PRINT #1,CHR$(Q);:PRINT CHR$(Q);
2540 M=M+1
2550 GOTO 2500
2560 CLOSE:PRINT E$+"y1":M=38200!:GOTO 500
2570 REM ************** BUFFER STATUS MESSAGE ******************
2580 IF M<=38200! THEN 3070 ELSE PRINT E$+"y1";:M=38200!:J=4:GOTO 3080
2590 I=M-38200!
2600 IF I<=0 THEN RETURN
2610 PRINT E$+";"
2620 PRINT E$+"x1"
2630 PRINT E$+"Y"+"0"+"42"
2640 PRINT E$+"p"
2650 PRINT"   There is a";I;"Byte message in the buffer.   "
2660 PRINT E$+"q"
2670 PRINT E$+"k"
2680 RETURN
2690 REM ******************    READ BUFFER   ROUTINE   ************
2700 OUT 220,0
2710 IF M<=38200! THEN 3070
2720 PRINT:PRINT
2730 I=1
2740 PRINT CHR$(27)+"E":PRINT CHR$(27)+"H"
2750 I=38200!
2760 C=PEEK(I)
2770 IF C=255 THEN PRINT:GOTO 2820
2780 PRINT CHR$(C);
2790 I=I+1
2800 IF INP(232)=4 THEN 500
2810 GOTO 2760
2820 PRINT:PRINT"END OF BUFFER:";:INPUT"   Press RETURN for MENU";A$
2830 GOTO 500
2840 PRINT:PRINT:REM ************** CANNED MESSAGE ******************
2850 OUT 220,1
2860 GOSUB 3030
2870 X$="    TRANSMITTER HERE IS FT-101 (HF) AND TS-700A (VHF).@
ANT: CUSH-CRAFT, AT-4 VERTICAL (HF) AND 1/4 WAVE VERT. (VHF).@
TTY TU: HAL, ST-5. COMPUTER HEATH H-89, RUNNING HDOS & MBASIC.@
QTH: AUSTIN TEXAS."
2880 I=1
2890 L2=LEN(X$)+1
2900 A$=MID$(X$,I,1)
2910 IF I=L2 THEN 1820
2920 P=ASC(A$)
2930 IF P<>10 THEN 2970
2940 IF FL=1 THEN 2960
2950 P=13:GOSUB 1580:PRINT:P=10:GOSUB 1580:GOTO 3000
2960 P=8:GOSUB 1580:P=2:GOSUB 1580
2970 PRINT A$;
2980 IF FL=1 THEN L=P:GOSUB 1380:GOTO 3000
2990 GOSUB 1580
3000 I=I+1
3010 GOTO 2900
3020 REM ************ CR's & LF FOR START OF TRANS ROUTINES ************
3030 FOR I=1 TO 100:NEXT I:IF FL=1 THEN 3050
3040 P=13:GOSUB 1580:P=13:GOSUB 1580:P=10:GOSUB 1580:RETURN
3050 P=31:GOSUB 1580:P=8:GOSUB 1580:P=8:GOSUB 1580:P=2:GOSUB 1580:RETURN
3060 REM ************ EMPTY BUFFER MESSAGE  ********************
3070 J=0
3080 OUT 220,0
3090 PRINT E$+"x5";
3100 PRINT E$;CHR$(89);CHR$(54);CHR$(60);
3110 PRINT "   NO MESSAGE IN BUFFER"
3120 FOR I=1 TO 200:NEXT
3130 PRINT E$;CHR$(89);CHR$(54);CHR$(60);E$+"K"
3140 FOR I=1 TO 50:NEXT
3150 J=J+1
3160 IF J=6 THEN 710
3170 GOTO 3100
3180 END
3190 DATA 0,69,10,65,32,83,73,85,13,68,82,74,78,70,67,75,84,90
3200 DATA 76,87,72,89,80,81,79,66,71,0,77,88,86,0
3210 DATA 0,51,10,45,32,7,56,55,13,36,52,39,44,33,58,40,53,42
3220 DATA 41,50,35,54,48,49,57,63,38,0,46,47,61,0
3230 DATA 31,31,31,31,31,31,31,5,31,4,2,31,31,8,31,31,31,31,31
3240 DATA 31,31,31,31,31,31,31,31,31,31,31,31,31,4,13,17,20,9,5
3250 DATA 26,5,15,18,20,17,12,3,28,29,22,23,19,1,10,16,21,7,6,24
3260 DATA 14,14,15,30,18,25,31,3,25,14,9,1,13,26,20,6,11,15,18,28
3270 DATA 12,24,22,23,10,5,16,7,30,19,29,21,17,15,29,18,3,3,5
3280 DATA 64,64,64,0,64,0,64,0,0,0,64,0,0,0,64,0,64,64,64,0,64,64,64
3290 DATA 0,0,0,64,0,64,0,64,0,64,64,64,0,64,64,64,0,0,0,64,0,64,64,64
3300 DATA 0,64,0,0,0,64,0,64,64,64,0,64,64,64,0,0,0,64,0,64,0,64,64,64
3310 DATA 0,0,0,64,64,64,0,64,0,64,0,64,64,64,0,64,0,0,0,64,0,64,0,64
3320 DATA 0,64,0,64,0,0,0,0,64,64,64,0,64,0,64,64,64,64,0,0,0,0,0,0,1
3330 DATA 32,68,69,32,87,51,82,87,85,47,53,13
3340 END
```

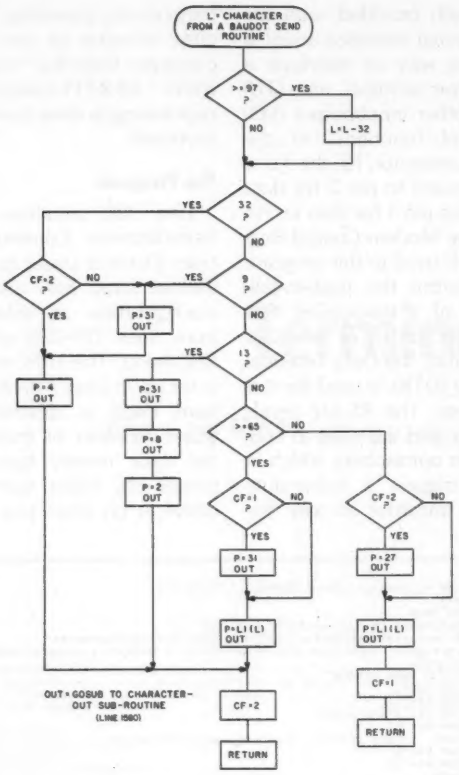


Fig. 1. Baudot send routine.

(RUN) the program. Line 300 sets a flag (FL) to 0 or 1 depending whether ASCII or Baudot is selected. Line 150 initializes a flag (CF) for Baudot upper- or lowercase. (2 = lowercase "letters.")

If Baudot is selected, lines 450–480 create arrays to convert ASCII characters to Baudot and vice versa. ASCII, of course, needs no conversion, so line 440 skips the arrays if ASCII is selected.

After selection of the mode/speed, lines 510–720 create the second menu, which will appear to the right of the first menu. Lines 510 and 710 turn the cursor off and on.

ASCII Receive

Lines 740–910 take ASCII characters from data-input port 216, print them on the screen, and send them to the printer port, 224. If during reception it is desired to store the message or any part thereof, striking a CTRL-K (ASCII 11) will place all incoming data in a memory buffer. Lines 880 and 890 accomplish this. Line 890 places the character in memory starting at address 38200 (decimal), increments once and inserts a decimal 255 (all bits "1"). Line 900 permits this buffer to extend to 56000, then resets to 38200, an 18K buffer. (If you have 48K RAM, the top should be set to 4000.) This buffer is not lost when returning to "SEND" or the menu, but to continue placing characters into the buffer after touching any key subsequent to the CTRL-K, it will be necessary to again hit the CTRL-K. This is because the last key struck remains in the keyboard port (232) until another key is struck. By the same token, striking any key after the CTRL-K (during receive) will halt placing characters into the buffer.

Line 780 checks the Line Status Register of the UART (ACE) to see if it is ready to accept another character. Bit 0 of this port (221) is set to logic 1 whenever a complete incoming character has been received and transferred to the receiver-buffer register of the ACE. If this bit is 0, line 810 loops the program back to line 780 and waits for the next character. In line 780, the byte from port 221 is logically ANDed with a one to toss out all but the first bit, bit 0. During this looping period, lines 790 and 800 check the keyboard to see if a CTRL-T or CTRL-D was struck to exit the routine.

The incoming-data byte is ANDed with 127 in line 820 to toss out the eighth, parity bit. This also has the effect of subtracting 128 from any received extraneous-noise characters between 128 and 255 decimal. Line 850 filters out these unwanted characters. Likewise, line 830 filters out a "form-feed" and line 840 gets rid of an "ESCAPE" character. Reception of an ESC followed by random characters can produce disastrous results. Line 860 prints the character to the screen and 870 sends it to the printer port.

Baudot Receive

The Baudot receive routine, lines 920–1200, has two loops—one for uppercase (FIGs) and one for "letters" (LTRs). The program jumps back and forth between them as it senses an incoming upshift, FIG character, line 1000, or a downshift LTR character, line 1130. The Baudot letters are converted to ASCII characters in line 1010, or Baudot FIGs converted to ASCII in line 1140. These conversion arrays were created from "DATA" in lines 3190–3220. Lines 990 and 1120 get the Baudot characters and AND them with 31 to toss out all but the five Baudot data bits.

Keyboard Transmit

Transmitting from the keyboard is accomplished in lines 1210–1360. Line 1220 turns the transmitter on, and the subroutine directed to in line 1230 is used at the start of all transmit routines. It provides a slight delay after turning on the transmitter and outputs two carriage returns and a line feed. The statement "INPUT$(1)" causes MBasic to read one character from the keyboard. P=ASC(X$) returns the ASCII code of X$ (line 1240). Line 1300 prints the character on the screen and sends it to the printer for hard copy (if the printer was turned on). Striking the RETURN key for a new line does not issue a line feed with this system. This is taken care of in lines 1310 and 1350. If the mode selected was ASCII, no conversion is required and the characters are sent to the output subroutine, lines 1580–1640. If Baudot was selected, then the characters are sent to the following subroutine.

Baudot Send Subroutine

Operation of this subroutine is best described with the aid of the flowchart, Fig. 1. The character flag, CF, has been set to 2 (LTRs) at the start of the program. ASCII characters from other routines enter as ASCII code integers, variable "L". The first line tests to see if they are lowercase ASCII (more than 97, beyond the range of conversion array L1, 0 to 97). If so, 32 is subtracted, making them uppercase ASCII. Next the character is tested to see if it is a "space." If so, a further test is performed to see if the previous character was a FIG or a LTR (Baudot). If both conditions are met, it sends out a Baudot space (4), sets the flag to 2, and returns. If the previous character was a FIG character, then a LTR (downshift) is sent before the Baudot space.

Next the program checks for a horizontal tab (ASCII 9). Tabs will not be processed, but a space will be

issued in Baudot. Line 1410 checks for a carriage return. If there is one, the program will send out a: LTRs, CR, and LF. If the character was not a CR, line 1420 makes the decision whether the character will be a Baudot upper (FIG) or a lower (LTR). All ASCII characters less than 65 will be Baudot FIGs. From here the previous character is checked for FIG or LTR by testing the CF flag. If the present character is different from the previous, with respect to FIG or LTR, the appropriate FIG or LTR shift is transmitted prior to the character. The ASCII character is converted to its Baudot code from the array in line 1440 or 1490. (DATA lines; 3220–3270.) If the present character is the same case as the previous, no shift command is given, the appropriate flag is set, and the program RETURNs to the proper routine.

Character-Out Subroutine

Timing speed (baud rate) is controlled by the UART (ACE). Lines 1590 and 1610 loop until the ACE is ready for another character. During this looping, line 1600 checks the keyboard for a CTRL-D to exit the routine and go to the menu. The CLOSE is there in case the EXIT was from reading an OPEN disk file. Line 1630 sends the character to the output port (216).

Transmit a File from Disk

Line 1710 reads one character from the disk file. Line 1720 returns the ASCII code of the character. HDOS/MBasic strips off all CRs when writing to a disk file. Line 1740 tests for this CR that the disk issues from sensing an LF. In this case, lines 1750 and 1760 will send out the required CR and LF.

The character is printed on the screen, and then the program loops back for the next character. Upon sensing the end-of-file (EOF), the file is closed and the program exits to the transmit keyboard.

RY Test and CQ Test

These are merely loops to read and send RYs (*U in ASCII) or CQ with a space. The end of these for-next loops drops to the call-sign loop, the DATA statement at line 330. These are ASCII codes for: "space DE W3RWU/5 space." Change this line of data for the call-sign of your choice. At the end of each line of test (or CQ), the keyboard is checked for a command to exit the loops and go to either keyboard send, CW ID, or the menu.

CW ID Routine

This routine uses the Line Control Register of the ACE to send a Morse CW ID. If bit 6 is set to a logic 1 (by sending a 64 to port 219), the serial-output ACE is forced to a space. When bit 6 of this port is set to a logic 0, it is forced to a mark. The data characters in lines 3280–3320 send my call. Three consecutive 64s are a dah, one 64 is a dit. Three consecutive 0s are a space between characters, and one 0 is the space between dits and dahs within characters.

This port (219) controls the bit configuration of the ACE, therefore it must be restored to its proper "BCON" at the end of this routine. Line 2300 sets the argument of variable B to this setting and 2380 puts B back into the port. Line 2410 is a delay to set the CW speed to about 15 wpm. Lines 2310 and 2320 put a reverse video message on screen, and lines 2360 and 2370 take the message off when the ID is finished and the program exits to the receive routine.

Write Buffer to Disk

This routine writes a simple sequential file to disk from what was stored in the buffer memory as loaded from the receive routine above. If the buffer is empty, line 2450 will vector the program to the "Buffer Empty" message and return to the menu.

Buffer Status Message

This routine is processed when anything is in the buffer as a result of a CTRL-K during receive. Variable I in line 2590 determines how many bytes are in the buffer, and lines 2610–2670 display this quantity on the 25th line.

This message will now stay on the 25th line until erased by selecting "8" of the menu or reading the buffer to disk (or re-RUN the program).

Read Buffer Routine

This routine will simply read back to the screen whatever is stored in the buffer.

Canned Message Routine

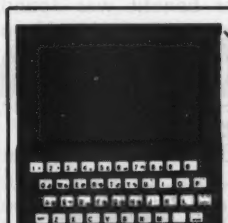
Here is a canned "brag" message that can be 256 bytes in length. The string X$ is the message and the @ will issue a CR and LF, although it is one continuous line in MBasic. Line 2980 reads the string one character at a time, and line 2910 tests for the end established in line 2890.

Empty Buffer Message

If the buffer is empty upon selection of 7, 8, or 9 of the menu, this subroutine will superimpose "No Message In Buffer" over the "SELECT NO." statement of the menu. This is accomplished using the direct cursor-addressing feature of HDOS.

This program should be easily adaptable to other machines using MBasic by appropriate changes to the commands and statements esoteric to the H-89, e.g., cursor addressing, screen blanking, port address, etc. Of course, the versatile features of the 8250 ACE are required for this program to work without timing delays.

Many thanks go to Dale Cockle K5JIC for his patient testing and helpful suggestions to get the program running.■



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Malley's Manchester Monitor

Listen in on the world's finest conversationalist—you!

Over the past several years my Yaesu FT-101E has been modified rather extensively. This was due in part to an interest in improving the receiver section for contesting. The other factor was an uncontrollable need for its owner always to have a hot soldering iron in his hand. In any event, the radio gradually improved to the point where it seemed to play as it should from a competitive sense. However, a new feature became desirable during the past year—the ability to monitor the transmitter's audio in the headphones.

When the manufacturers initially introduced the monitor feature, it seemed more like another bell or whistle than the solution to a real need. Perhaps it still is, but I have found that there are several reasons that make this feature rather convenient.

The first hint of desirability came when I was operating a multi-operator/single-transmitter (multi-single) DX phone contest. We found that having boom-microphone headsets for both operators was invaluable when working split frequency on 40 meters. This is necessary since European amateurs cannot transmit above 7100 kHz. Here the monitor function allowed both of our operators to know when the other was transmitting. Another benefit was found when using a closed-loop CQ tape; there was less clutter involved in patching the tape-recorder audio into the operator's headphones.

You may be thinking that this might be great but if you're not a contester, who needs it? Well, I have found that there's something of a psychological boost to hearing your audio directly in the headphones during normal SSB operation. Also, commercial full-duplex FM headsets are used for communication in high-noise areas at work. These radios also have a monitor feature which the operators find really helpful.

Having determined the fundamental need for yet another convenience item, it became necessary to determine how to add it to the transceiver. The typical circuit in commercial amateur rigs involves diode detection in one of the i-f stages. This procedure was selected presumably to allow the operator to hear the actual transmitted audio quality. It is a relatively complicated method and one which some believe does not accurately represent what the receiving station actually listens to (because of propagation delays and the detection circuitry itself). These considerations led me to sampling at audio frequencies, which is basically quite simple. While this article presents installation details which specifically relate to the FT-101E, the modification should apply to many other transceivers with minor changes.

The audio unit in the FT-101E is designated PB1315. One output of this circuit board goes to the transmitter modulator/oscillator section (PB1184A). Oscilloscope measurements showed that this audio output level was insufficient to properly drive the headphones. Consequently, a simple IC amplifier stage was required.

One of the restraints that was placed on the design was that only a single supply voltage be necessary so that the +13.5 V dc in the FT-101E could be used. Another was that all parts be locally available. An LM386 met these simple requirements and is capable of supplying about 0.4 Watts of output power. This is a popular IC which has been used for the audio section of direct-conversion receivers. These receivers require a very high audio gain to offset their typical lack of an rf amplifier stage. This linear IC can be configured as either a 20× or 200× amplifier. For our purposes, the lesser gain is more than enough and requires slightly fewer parts.

The circuit for the monitor board is shown in Fig. 1. The audio input to the LM386 is supplied through a disc-ceramic capacitor and a potentiometer gain control. A voltage divider is provided at pin 6 to drop the transceiver supply voltage from 13.5 V to 8.5 V, which is approximately the midpoint of the 4–12-V-dc allowable range for the LM386. This voltage is bypassed with a 0.01-uF capacitor to keep transients out of the chip. Note: A 10-uF electrolytic capacitor can be connected between pins 1 and 8 *if a 200× gain were desired for another application.* In this case, the negative side of the capacitor is connected to pin 8.

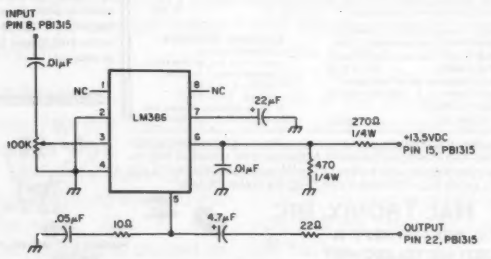

Fig. 1. The circuit for the monitor board.

The circuit can be assembled on a piece of perfboard or on an etched circuit board. Parts placement is not critical, although the bypass capacitor should be located as close as possible to pin 6. The PC board, foil side, is shown in Fig. 2.

Connect the monitor board input to pin 8 of PB1315 and the resistive divider to pin 15 or 16 of PB1315. The monitor output should be attached to PB1315, pin 22, which feeds the headphones. Miniature coax (RG-174) was used for these connections to eliminate any possibility of rf problems.

One of the more difficult problems encountered in modifying modern transceivers is finding a place to mount extra circuitry. I chose mounting the board on edge between the audio and modulator/oscillator units using one of the existing posts for support. This lets you adjust the amplifier gain if necessary and provides more space than that available under the rig's chassis. Once assembled, all that remains to be done is to talk into the microphone and adjust the pot until a comfortable audio level is heard in the headphones. It is advisable to turn the receiver's volume control off before setting this level since the receiver will be muted while you are transmitting. The monitor's gain pot is wired so that it can be turned off entirely if that should ever be desirable.

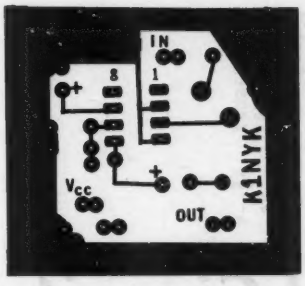

Fig. 2. PC board, foil side.

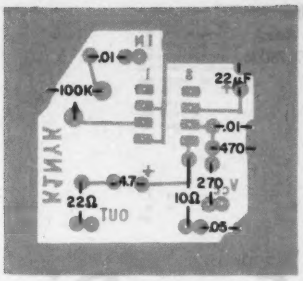

Fig. 3. Parts placement.

This is a simple modification that can be performed in a couple of hours at a leisurely pace. Thus, it is well suited for the newcomer to home-brew work. All parts can be obtained from your local Radio Shack store, as shown in the Parts List. Considerable variations in the electrolytic values can be made without significant effects. Likewise, the voltage divider can use other values as long as the voltage range noted above is not exceeded.

I have found that the monitor function has performed very well with good-quality microphone audio present in the headphones. Drop me a line if you have any questions on this modification (an SASE would be appreciated). ■

Parts List

2	.01 uF	RS272-131
1	.05 uF	272-134
1	4.7 uF	272-1024
1	22 uF	272-1026
1	10 Ohms	272-001
1	22 Ohms	271-005
1	270 Ohms	271-1314
1	470 Ohms	271-1317
1	100k Ohms	271-220
1	LM386	276-1731

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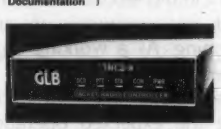

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Microprocessors incorporate a set of logical operators in their instruction code. Basic interpreters and compilers usually incorporate these features also. Even if your Basic does not include Boolean operators, you can still analyze digital logic circuits with it.

I became interested in the application of the Basic language to the analysis of digital circuits about the time I got my computer up and running. As a working engineer, I am acutely aware of the tedious nature of defining the expected operation of a digital circuit by hand. The possibility of reducing the effort needed to define the operation of a circuit was sufficient encouragement to pursue the possibility of doing it by computer. Although custom circuit-analysis programs have existed for about as long as the electronic computer, their cost and availability exclude the average user. The application of Basic to the problem promised a method of analysis and also provided an excellent opportunity to better understand the Basic language itself.

Let us then proceed in the following manner: First, we will investigate the existing logical operators. Then, we will define equivalents for the brethren who do not have the Boolean functions. Finally, we will develop some additional logic circuits with applications. The logic (or Boolean) operators normally encountered in microprocessor languages include the OR gate, the AND gate, and the XOR (exclusive OR) gate. Additionally, an equivalent of the exclusive NOR, the NOT, and additional functions may be had. The usefulness of functions other than the OR, AND, and the XOR is questionable, as they may not be defined for binary logic and may produce results which are not expected. For example, the NOT function on my machine is a two's complement of the sum of a number and one. The answer comes out as a negative number. The best solution is to use what you have but make sure that what you have works. Generate (or look up) a truth table for the operation you are verifying. If it works, use it. If it produces weird answers, don't use it.

If you have any Boolean functions in your Basic, they are probably:

- OR—Used to OR two words together. We will limit our words to the numbers 0 and 1. Although the possibility of using numbers from 0 to 255 (for 8-bit words) makes 16-bit-wide input gates possible, one must crawl before one can walk.
- AND—Same as OR except it performs the AND operation.
- XOR—If you have it, it exclusive ORs two numbers.

If we write a simple program to illustrate the use of these functions, it will look something like this (for standard or ANSI Basic):

```
10 FOR A=0 TO 1
20 FOR B=0 TO 1
30 PRINT A OR B;
40 NEXT B
50 PRINT
60 NEXT A
```

If we run this short program, we will get a display which looks like this:

```
0  1
1  1
```

The first line represents the ORing of A and B when A is 0 and B is first 0 then 1. The second line is for A = 1 and B is first 0 then 1. This is indeed the correct result of the operation of an OR gate. If AND is substituted for OR in the above program, the display will be:

```
0  0
0  1
```

This is the correct result for the ANDing of two digital signals. In like fashion, the XOR operator produces:

```
0  1
1  0
```

The first operator we will define is the inverter. This is an absolute necessity if we do any TTL analysis. Fortunately, the function is easy to obtain. For applications where we wish to recognize the invert operation, we can call this INV. We can define the operation as:

```
10 INV(0)=1
20 INV(1)=0
```

The application of this is shown as Inverter Operation in Listing 1, lines 10 and 20, where it is used to change an AND function to a NAND function. Instead of the name

```
5 REM ********************INVERTER OPERATION
10 INV (0) = 0 XOR 1
20 INV (1) = 1 XOR 1
25 PRINT:PRINT "NAND GATE":PRINT
30 FOR A=0 TO 1
40 FOR B=0 TO 1
50 PRINT INV(A AND B);
60 NEXT B
70 PRINT
80 NEXT A
90 END

Ok
RUN

NAND GATE

 1  1
 1  0
Ok
```

Listing 1.

```
5 REM ********************NAND GATE
10 LET N(1)=0
20 LET N(0)=1
30 FOR A=0 TO 1
40 FOR B=0 TO 1
50 S= N(A*B)
60 PRINT S;
70 NEXT B
75 PRINT
80 NEXT A
90 END

Ok
RUN
 1  1
 1  0
Ok
```

Listing 2.

```
5 REM ********************NOR GATE
10 LET N(1)=0
20 LET N(0)=1
30 FOR A=0 TO 1
40 FOR B=0 TO 1
50 S=N(A)*N(B)
60 PRINT S;
70 NEXT B
75 PRINT
80 NEXT A
90 END

Ok
RUN
 1  0
 0  0
Ok
```

Listing 3.

```
5 REM ********************OR GATE
10 FOR A=0 TO 1
20 FOR B=0 TO 1
30 INV(0)=1
40 INV(1)=0
50 PRINT INV(INV(A)*INV(B));
60 NEXT B:PRINT
70 NEXT A
80 END

Ok
RUN
 0  1
 1  1
Ok
```

Listing 4.

```
5 REM ********************XOR GATE
10 INV(0)=1
20 INV(1)=0
30 FOR A=0 TO 1
40 FOR B=0 TO 1
50 PRINT INV(INV(A*INV(B))*INV(INV(A)*B));
60 NEXT
70 PRINT
80 NEXT

Ok
RUN
 0  1
 1  0
Ok
```

Listing 5.

```
10 REM ********************ADDER
20 INV(1)=0
30 INV(0)=1
40 DEF FNS(C,X,Y)=(INV(C)ANDINV(Y)ANDX) OR (INV(C)ANDYANDINV(X)) OR (CANDINV(Y)A
NDINV(X)) OR (CANDYANDX)
50 DEF FNCA(C,X,Y)=(XANDC) OR (XANDY) OR (YANDC)
51 PRINT:PRINT:PRINT:PRINT
52 PRINT "S and C outputs for inputs X,Y and CARRY equal to"
53 PRINT
60 PRINT SPC(4);"X,Y= 0,0";SPC(5);"1,0";SPC(5);"0,1";SPC(5);"1,1"
70 PRINT "CARRY";:FOR Z=1 TO 32:PRINT "-";:NEXT:PRINT
80 FOR C=0 TO 1
90 PRINT C;SPC(2);":";SPC(2);
100 FOR Y=0 TO 1
110 FOR X=0 TO 1
120 PRINT FNS(X,Y,C);FNCA(X,Y,C);SPC(2);
130 NEXT
140 NEXT
150 PRINT
160 NEXT


Ok
RUN

S and C outputs for inputs X,Y and CARRY equal to

    X,Y= 0,0     1,0     0,1     1,1
CARRY------------------------------------
  0    1   0 0   1 0   1 0   0 1
  1    1   1 0   0 1   0 1   1 1
```

Listing 6.

```
5 REM ********************JK FLIP FLOP
10 LET B=1
20 LET CK=0
30 LET Q=0:E=0
40 INPUT "Enter 0 or 1 for J";J
50 INPUT "Enter 0 or 1 for K";K
60 INV(0)=1
70 INV(1)=0
80 FOR I=1 TO 20
90 IF J=CK=E=1 THEN Q=1
100 IF K=CK=INV(E)=1 THEN Q=0
110 PRINT Q;
120 IF CK=B=1 THEN E=INV(E)
130 CK=INV(CK)
140 NEXT
150 END


Ok
RUN
Enter 0 or 1 for J? 0
Enter 0 or 1 for K? 0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
Ok


RUN
Enter 0 or 1 for J? 0
Enter 0 or 1 for K? 1
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
Ok


RUN
Enter 0 or 1 for J? 1
Enter 0 or 1 for K? 0
  0  0  0  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
Ok


RUN
Enter 0 or 1 for J? 1
Enter 0 or 1 for K? 1
  0  0  0  1  1  0  0  1  1  0  0  1  1  0  0  1  1  0  0  1
```

Listing 7.

INV, we could use N (or for that matter any symbol which the computer will recognize). The use of the N with AND or OR functions better enables us to recognize the NAND or NOR operations. (See Listings 2 and 3).

For those who don't have logical operators, we can develop what we need from the arithmetic operators. The easiest to derive is the AND function. Since it is the same (for 0 and 1) for both logic and arithmetic, we can use the multiply (*) operator. A AND B can then be represented by A*B. For A and B having values of 0 or 1, the only case where A*B=1 is when both are 1, which defines the AND operation. The NAND gate can be derived by inverting the AND gate as shown in NAND GATE (Listing 2).

To derive the OR and NOR functions, we need to remember the Boolean identity which states, "inverting the output of an AND gate is the same as inverting the inputs of an OR gate." Conversely, "inverting the output of an OR gate is the same as inverting the inputs of an AND gate." (You might remember that the next time you need one type of gate and you have only the other.) The NOR gate is the easiest of the two to derive since it is the invert of A multiplied by the invert of B (see Listing 3). The OR gate is the invert of the NOR gate (see Listing 4). If you don't have the exclusive OR function, you should remember that: A XOR B = (INV(A) AND B) OR (B AND INV(A)). The XOR gate can also be derived without the aid of built-in logical operators, as seen in Listing 5.

If you have the define function (DEF FN), you can use it to generate additional logic operations such as the ADDER (see Listing 6). Additional logic functions such as flip-flops, counters, shift registers, etc., rely less heavily on strictly Boolean operations. For example, the J-K flip-flop can be represented without any Boolean operators (see Listing 7).

In analyzing circuits using counters, flip-flops, shift registers, and other devices using clocked signals, you should incorporate some method to ensure that your program simulates the clocked operation. Some cases exist where no special care need be taken (as in the following flip-flop example):

```
10 INV(0)=1
20 INV(1)=0
30 CK=0
40 Q=0
50 FOR I=1 TO 10
60 IF CK=1 THEN Q=INV(Q)
70 PRINT Q;
80 CK=INV(CK)
90 NEXT
```

It is usually necessary to provide some method of ensuring that the true clocked operation is simulated. This is accomplished in the above example by use of the INV(CK). Since CK is 1 every other alternation, Q will invert every other cycle, simulating a by-two frequency divider. In most cases, however, this is not sufficient, as often some form of gate is used to interrupt the clock signal. The result of this on the above routine will be a continual flipping of Q if CK is gated to a continuous high. This can be circumvented fairly easily by the in-

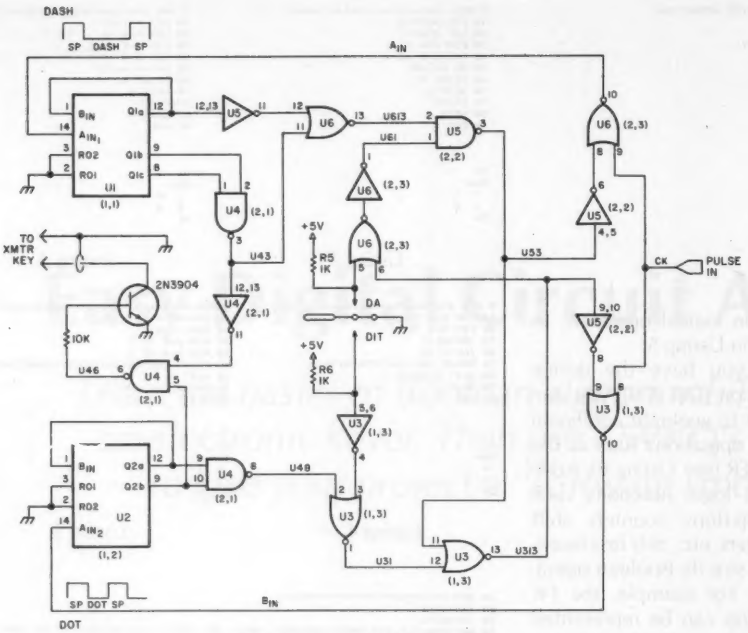

Fig. 1. Dot and dash generator.

```
10 REM ************************KEYER
20 D$="SPACE"
30 DA=1
40 DIT=1
50 CK=0
60 ACP=1:BCP=1
70 U53=0:U313=0
80 INV(1)=0
90 INV(0)=1
100 FOR I=1 TO 5:D(I)=INT(2*RND(1)):NEXT
110 Q1A=D(1):Q1B=D(2):Q1C=D(3):Q2A=D(4):Q2B=D(5)
120 INPUT "ENTER 'DASH', 'DOT' OR 'SPACE';(enter 'QUIT' to end)";D$
125 LPRINT D$
130 IF D$<>"SPACE" AND D$<>"DASH" AND D$<>"DOT" THEN GOTO 420
140 FOR I=1 TO 20
150 CK=INV(CK)
160 IF D$="DASH" THEN DA=0 ELSE DA=1
170 IF D$="DOT" THEN DIT=0 ELSE DIT=1
180 IF CK=0 THEN D$="SPACE"
190 U43=INV(Q1B AND Q1C)
200 U613=INV(U43 OR INV(Q1A))
210 U61=DA OR U313
220 U53=INV(U613 AND U61)
230 U48=INV(Q2A AND Q2B)
240 U31=INV(U48 OR INV(DIT))
250 U313=INV(U31 OR U53)
260 AIN=INV(INV(U53) OR CK)
270 IF AIN + ACP=0 THEN Q1A=INV(Q1A)
280 IF AIN + ACP + Q1A=0 THEN Q1B=INV(Q1B)
290 IF AIN + ACP + Q1A + Q1B=0 THEN Q1C=INV(Q1C)
300 ACP=1
310 IF AIN=1 THEN ACP=0
320 BIN=INV(INV(U313) OR CK)
330 IF BIN + BCP=0 THEN Q2A=INV(Q2A)
340 IF BIN + BCP + Q2A=0 THEN Q2B=INV(Q2B)
350 BCP=1
360 IF BIN=1 THEN BCP=0
370 U46=INV(U43) AND Q2B
380 LPRINT U46;
390 NEXT I
400 LPRINT:LPRINT
410 GOTO 120
420 END

SPACE
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

DASH
 1  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  1  1  1  1  1  1

DOT
 1  1  0  0  0  0  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

SPACE
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

SPACE
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

SPACE
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

DOT
 1  1  0  0  0  0  1  1  1  1  0  0  0  0  1  1  1  1  0  0

DOT
 0  0  1  1  1  1  0  0  0  0  1  1  1  1  0  0  0  0  1  1

SPACE
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

SPACE
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

DASH
 1  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  1  1  1  1  0  0

DASH
 0  0  0  0  0  0  0  0  0  0  0  0  1  1  1  1  0  0  0  0  0  0
```

Listing 9.

corporation of a gating function, as shown in Listings 7 and 8 (the E in the J-K flip-flop and the A in the D flip-flop). These slightly different approaches produce the same result; that is to prevent the output from flipping without the proper clock signal.

Proper gated operation can be accomplished by gating this signal as an enable or by gating CK. CK can be gated by adding a gate in the D flip-flop or by using B in the J-K flip-flop. Either an AND gate can be used (as in the J-K flip-flop) or an OR gate can be added.

The schematic (Fig. 1) is of an electronic keyer which I built some time ago. It uses a 555 oscillator as an input and generates an output with a dot-to-space-to-dash ratio of 1 to 1 to 3, with self-completing dots and dashes. Speed control is obtained by controlling the frequency of the 555 oscillator. The key is a typical single-pole, double-throw switch normally used on electronic keyers. (I made mine from a telephone polar relay which I obtained from a surplus store.)

To verify that the circuit

```
5 REM ********************D FLIP FLOP
10 QA=0:D=0:A=1
20 INV(0)=1
30 INV(1)=0
40 PRINT "CK";"  D";" QA";" QB"
50 FOR I=1 TO 10
60 CK=INV(CK)
70 B=A OR CK
80 IF B=0 THEN QA=D
90 IF CK=1 THEN A=0 ELSE A=1
100 QB=INV(QA)
110 IF I=5 THEN D=1
120 PRINT CK;D;QA;QB
130 NEXT
140 END

Ok
RUN
CK  D  QA  QB
 1  0   0   1
 0  0   0   1
 1  0   0   1
 0  0   0   1
 1  1   0   1
 0  1   1   0
 1  1   1   0
 0  1   1   0
 1  1   1   0
 0  1   1   0
```

Listing 8.

performed as expected, I wrote the keyer program to simulate the operation of the keyer (Listing 9). The program-run shown under the listing is the simulation of the circuit operation for an output of "spaces," "dot," and "dash"—i.e., one dot or one dash. This verifies the self-completing nature of the dots and dashes and also the dot-to-dash ratio. It can be seen that four clock pulses are necessary to complete one dot. The dashes are three times the length of the dots or twelve clock pulses long. The oscillator must then run at four times the dot rate (twelve times the dash rate) to obtain the desired speed.

To simulate keydown operation, line 160 must be removed. This prevents the program from assuming a "space" when the clock goes low. In fact, it forces the program to assume that the input condition (dot, dash, or space) remains until directed otherwise. The program (i.e., circuit) continues to generate the proper dot-to-space and dash-to-space ratios when running either dots or dashes.

The initial (i.e., power-up) conditions are established in lines 10 to 100. Either random (lines 90 and 100) or predetermined (line 60) may be used to define the initial conditions. The ACP and BCP signals are introduced into the program to simulate the edge-clocked operation of the counters. Without this

function, the counter is not restricted to counting only when the clock is toggled; it will count as long as CK is 0 if this function is not present. This is accomplished by lines 270, 280, 290, and 330, 340. ACP and BCP are set to 1 each time through and can only be set to 0 when AIN and/or BIN are/is set to 1. This results in counting occurring only when the clock is toggling. This or a similar procedure is necessary whenever a clocked-type operation is simulated. Lines 110 through 370 simulate the actual operation of the circuit.

The system which I used to assign variable names was to use the device name followed by the pin number—for example, U310 corresponds to device number U3, pin 10. This procedure may not work with your computer, however. It may be necessary to choose simpler names to ensure proper circuit operation. Otherwise, the computer can confuse the signals; e.g., if the computer is capable of recognizing variable names only two or three symbols long, it will confuse signals U310 and U31. This is determined by the Basic which you are using, so know what your Basic is capable of before you start assigning signal names.

If you decide that you need an economical keyer and wish to build one, a parts list and description of the operation of the keyer is included. It is very simple in operation, requiring only a single control for speed (plus a switch if you want multiple ranges) and working on the assumption that a space is one unit long, a dot is one unit long, and a dash is three units long. The circuit can be constructed from common parts found in your junk box or purchased at your local Radio Shack store.

The dash generator is composed of U1, NAND gates U4 (pins 1, 2, and 3) and U5 (pins 1, 2, and 3), OR

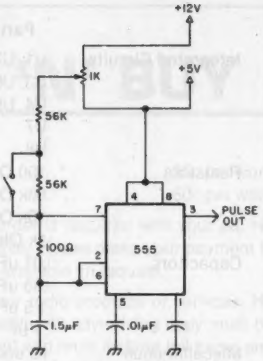

Fig. 2. Pulse generator.

gates U6 (two), and inverters U4 (output pin 11), U5 (output pin 11), and U6 (output pin 1). The dash circuit will toggle on power-up until QA, QB, and QC are all high. This will cause pins 11 and 12 of U6 to go low, driving pin 2 of U5 high. If the "paddle" is in the space or dot position, pin 1 will also be high. This will drive pin 3 of U5 low, which is inverted by inverter U5, driving pin 8 of U6 high, blocking further clock pulses to AIN. If pin 6 of U6 is low (more on that later), then moving the paddle to the dash position will cause pin 5 of U6 to also go low. This drives the output of the NOR gate high, which is inverted and drives pin 1 of U5 low. This results in pin 8 of U6 being driven low, which allows the clock signal (pulse in) to toggle U1 until the paddle is released and QA, QB, and QC are again all high. Additionally, until pin 3 of U5 goes low, signaling the end of the dash string, pin 11 of U3 will be held high, preventing the lower half of the circuit (dot generator) from functioning. The combination of the paddle being released and the necessity of QA, QB, and QC being high makes the dash self-completing.

In the truth table which follows, it can be seen that spaces occur during toggling when the count is 6 and 7, i.e., when pin 4 of U4 is high (pin 5 of U4 is held high as long as the dot generator is inactive). Since the

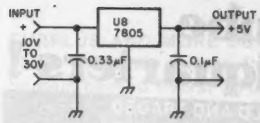

Fig. 3. Power supply.

total count is eight, and two counts are used for a space, the six remaining counts are reserved for the dash with a ratio of two to six (one to three).

7493 Truth Table

count	C	B	A
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

The dot generator is a simplification of the dash generator, requiring only the outputs QA and QB to generate the dots. As long as the paddle is held in the dot position, U3 pin 3 will be forced high, resulting in a low on pin 12 of U3. If the dash generator has completed its cycle, pin 11 of U3 will also be low. The resultant high on pin 13 of U3 will result in pin 6 of U6 being held high, blocking the dash generator, and pin 9 of U3 being driven low, allowing the clock pulse to toggle U2. Since the output is taken from QB, the dot-to-space ratio will be two to two (one to one). The dots will continue until the paddle is released and QA and QB are both high (i.e., the last dot is completed).

The pulse generator (Fig. 2) is a standard 555 circuit with minor exceptions. When varying the frequency in the normal manner, the resistance in series with the capacitor (the time-constant RC) is varied, which causes a nonlinear change in the charging current of the capacitor, forcing most of the frequency change to take place on one end of the control. By use of the potentiometer placed between the 12-V supply and the 5-V supply, the current supplied to the RC network will be linear. The frequency change will no longer have all of its change on only one end of the control. A decoupling capacitor (about 10 uF) can be connected to the center arm of the potentiometer to ensure maximum linearity, if so desired. Switch S1 can be used if desired to obtain a wider speed range. With the switch incorporated, the speed is about 5 wpm to 20 wpm in slow (S1 open), and about 10 wpm to 40 wpm in high (S1 closed).

The keying circuit is the output NAND gate, U4, the 10k resistor, and the 2N3904 transistor. This circuit was chosen to drive my Heathkit® HW-104 transceiver. If your transmitter requires a different keying method, you may redesign the output or insert a relay.

The 5-V supply (Fig. 3) is a 7805 regulator from the 12-V supply (most modern equipment is solid state and designed to run from 12 V). The .33-uF capacitor and the .1-uF capacitor are those recommended by the manufacturer when using the regulator.

As with all digital circuitry, a liberal sprinkling of decoupling capacitors should be used on the 5-V supply (one .1-uF capacitor at each device should be sufficient). Construction can be printed circuit if you care to lay out a board, or wire-wrap as mine is. I used 100-mil-spacing perfboard and wire-wrap sockets (both from Radio Shack) and wire-wrapped the circuit (using the little hand tool that Radio Shack sold me) when I was watching TV one night. The discrete components I mounted on a DIP header; I wire-wrapped a socket for them also. The cabinet is one of the small metal cabinets from the same source. You can either purchase a paddle or make your own as I did. If you have a surplus store in your area, look for a telephone polar relay. After the coil is removed, the remaining mechanical makes

Parts List		
Integrated Circuits	U1, U2	7493
	U3, U6	7402
	U4, U5	7400
	U7	555
	U8	7805
Resistors	100 Ohms	¼ W
	56k Ohms	¼ W (2 ea.)
	10k Ohms	¼ W
	1k Ohms	¼ W (2 ea.)
Capacitors	.01 uF	
	.33 uF	
	1.5 uF	15 V
	.1 uF	(7 ea., for decoupling)
Miscellaneous	IC sockets	(8 ea.)
	Potentiometer	1k
	SPST switch (optional)	
	Cabinet	(Radio Shack #270-251)
	100-mil-spacing perfboard	
	Wire and solder as needed	

an excellent paddle.

Incidentally, the above computer simulation discovered a quirk in the circuit that I didn't know existed until I ran the program. If the simulation is run in the continuous-dash mode without first running a space, the program will not toggle. If the keyer is powered up with the paddle held in the dash position (same condition as the simulation), the keyer will duplicate the condition first observed in the program.

Well, whether you build the keyer or something else, use the computer to simulate a circuit—or just read and forget. Have a happy QSO and 73. ■

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The problem may be solved by using switched crystal oscillators in the band generator or by using the PLL (phase-locked loop) method when constructing the band oscillator. The use of this method under nonprofessional conditions is difficult since the system is quite complex and involves the use of proper programmed dividers and a filter in the vco control system which is difficult to optimize and which has to operate over a large frequency range.

My solution is to use the FLL (frequency-locked loop) method for frequency stabilization of the band oscillator. The advantages of this method are a relatively simple system and the possibility of applying it to already-constructed equipment. The use of the FLL

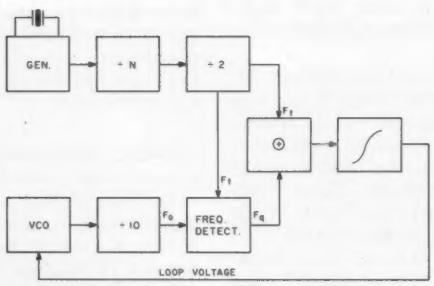


Fig. 1. Principle of operation of FLL synthesizer.

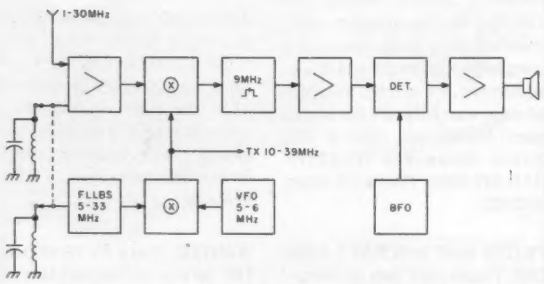


Fig. 2. Block diagram of radio receiver.

Received frequency F_R (MHz)	FLLBS frequency F_{H1} (MHz)	Vfo frequency F_{H2} (MHz)	Output frequency of heterodyne mixer (MHz)
1- 2	5.0		10-11
3- 4	7.0		12-13
7- 8	11.0		16-17
10-11	14.0		19-20
14-15	18.0	5-6	23-24
18-19	22.0		27-28
21-22	25.0		30-31
24-25	28.0		33-34
28-29	32.0		37-38
29-30	33.0		38-39

Table 1.

method for frequency stabilization of LC generators in the already-constructed equipment involves minimum system alterations while it considerably improves frequency stability.

Fig. 1 explains the principle of operation of the FLL system. The essential part is a flip-flop, type D, which functions as a harmonic mixer. Signals F_o from the vco and the clock signal, F_t, obtained from the quartz generator are supplied to its inputs D and C. The output signal of the flip-flop element, F_q, is expressed by the formula: $F_q = F_o - kF_t$, where k is a positive integer.

Obtaining the values of F_t and F_q as constants, we can change the frequency F_o in a function of the harmonic number k. In order to ensure constant frequency F_q, this frequency was compared with frequency F_t from the quartz generator. Both signals, F_t and F_q, are transformed into impulses with opposite polarization; added, their mean value is formed in the integrator, and they are amplified. From the amplifier output, the voltage of error is taken to adjust the frequency of the vco. Frequency F_q was, in my case, set at 50 Hz. Since frequencies F_t and F_q differ substantially, voltage levels F_t and F_q when added were also differentiated.

The Radio Receiver

The synthesizer constructed by me with the help of the FLL method is thought to be part of a radio receiver (and a transceiver in the future). A block diagram is shown in Fig. 2. As can be seen, the receiver system is of a conventional type. Single-frequency conversion was used with an i-f of 9 MHz. The vfo operates in the frequency range of 5 to 6 MHz. The receiver has ten bands. The determination of basic frequencies according to the formula $F_R = (F_{H1} + F_{H2}) - F_{i\text{-}f}$ and the determinations of the FLLBS synthesizer frequencies are given in Table 1.

The vfo is of a conventional construction: It is an LC generator. I intend to build a vfo also based on the FLL method, however. When constructing the whole receiver or transceiver, it is also possible to use the microprocessor vfos described in *73* (June, 1982); that output frequency is also 5–6 MHz.

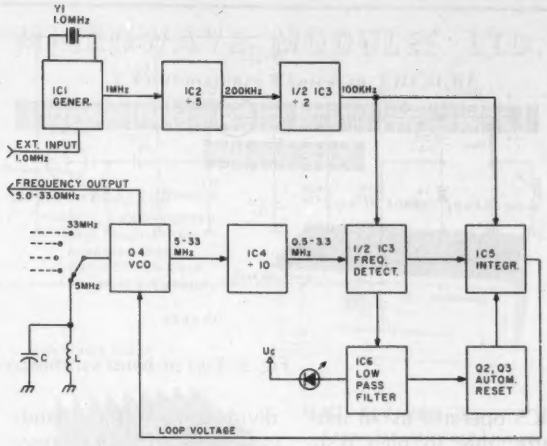


Fig. 3. Block diagram of band synthesizer.

The FLLBS Synthesizer

A block diagram of the synthesizer is presented in Fig. 3, while its schematic diagram is shown in Fig. 4 (digital part) and Fig. 5 (the vco) As can be seen from the drawings, the synthesizer is of a simple construction: All that is needed are several standard elements, and the cost of this system should not exceed ten to fifteen dollars.

The operation of individual parts of the system is as follows:

- The 1.0-MHz crystal oscillator is a typical one; it can operate on its own crystal or from an external 1.0-MHz generator.
- The next element (IC2) operates as a divider by 5; at its output (pin 11), a frequency of 200 kHz is obtained.
- The frequency detector (IC3) is based on a 7474 flip-flop. At its clock input (pin 11, IC3), a frequency of 100 kHz is supplied, obtained by dividing 200 kHz by the first flip-flop of IC3. To the input D of the detector (pin 12, IC3), a frequency obtained from the vco, preliminarily divided by 10 in the IC4 counter, is supplied.

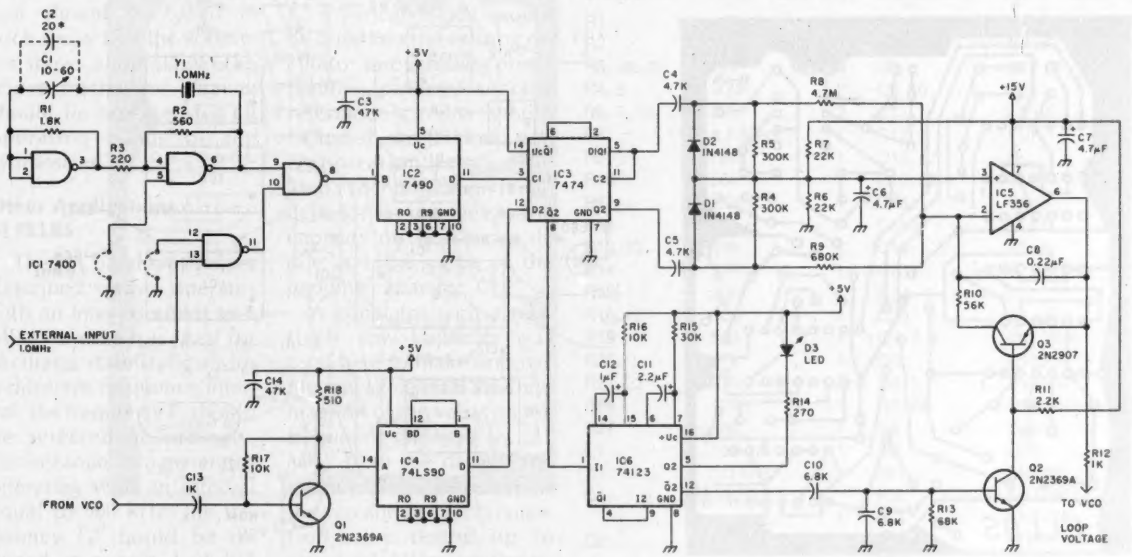


Fig. 4. Digital part of band synthesizer (FLLBS).

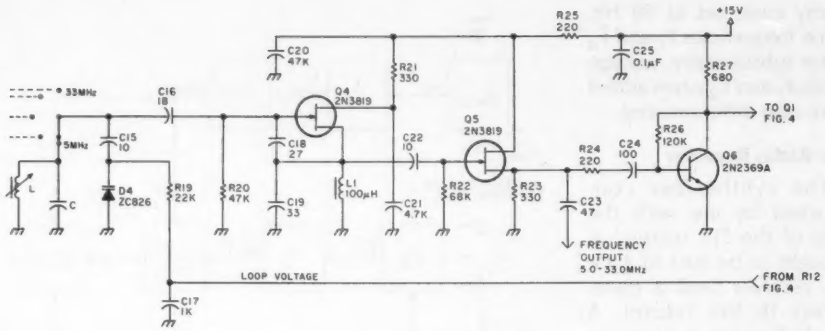


Fig. 5. Vco of band synthesizer.

- IC5 operates as an integrator; due to high resistances in the adding circuit, I constructed it with the use of an FET amplifier with high input resistance.
- IC6 functions as a low-pass filter; it has to detect and signal through the diode LED the state of desynchronization of the frequency-locked loop. Transistors Q2 and Q3 serve to neutralize the integrator when the vco is desynchronized and restore the state of synchronization of the loop.
- Desynchronization often takes place when changing the bands of the vco.
- The vco (Fig. 5) operates in a standard system. For individual operating bands (see Table 1), separate resonance circuits were used, changed by selector switch together with the corresponding input circuits of the receiver. The function of the switch may be also performed by contacts of relays. For tuning the vco, a varicap diode was used. At the generator output, a voltage follower from which the output signal is taken was used. The signal from the follower is amplified by transistors Q6 and Q1 and supplied to the counter from IC4.

Construction and Alignment of the FLLBS

The digital part of the system and the vco were placed on separate printed circuit boards. The purpose of this was to eliminate disturbing pulses from the digital part which could reach the receiver input through the vco. Depending on the actual mechanical design of the receiver, it might be necessary to enclose the digital part of the synthesizer in a shielded casing.

The vco, the voltage follower, and one stage of the amplifier were placed on a plate with the resonance circuits and the band-selector switch. Figs. 6 and 7 show the digital part of the synthesizer. The construction of the vco depends on the type of the band-selector switch used and the coil casing of the resonance circuits. The design of the vco PC board should be worked out individually, depending on the needs.

For the same reasons, I am not giving here the data for the LC circuits for individual bands; they should be selected according to the generally-known principles. All transistors and diodes used in my construction may be replaced by their more recent equivalents.

When aligning the crystal oscillator, pins 5 and 12 of IC1 should be properly connected. When working with a built-in crystal, pin 12 should be connected to ground and pin 5 left free; when using an external oscillator, it should be connected to the proper terminal pins of the PC board and pin 5 should be connected to ground, while pin 12 should be left free.

When aligning the synthesizer, a voltmeter should be connected to output 6 of IC5 and then controlling the vco frequency meter or a calibrated receiver, the vco resonance circuit of the vco should be tuned by means of the coil core to a fre-

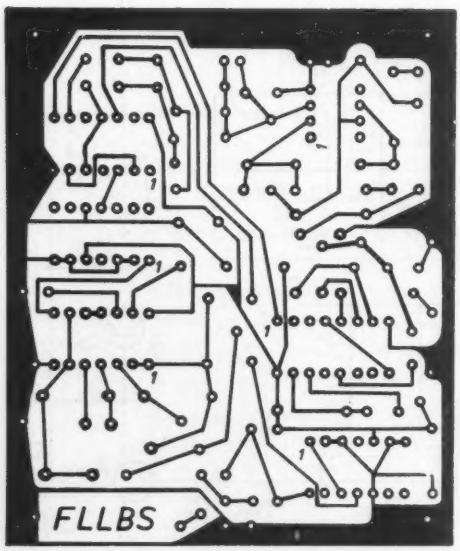


Fig. 6. Digital part of FLLBS PC board (foil side).

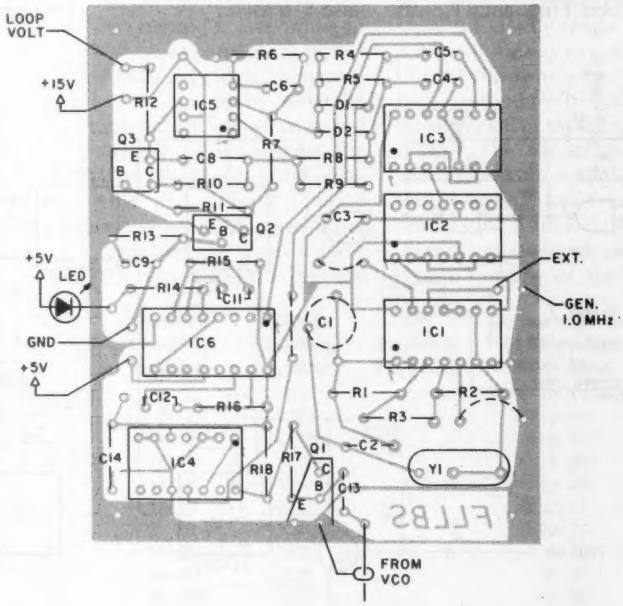
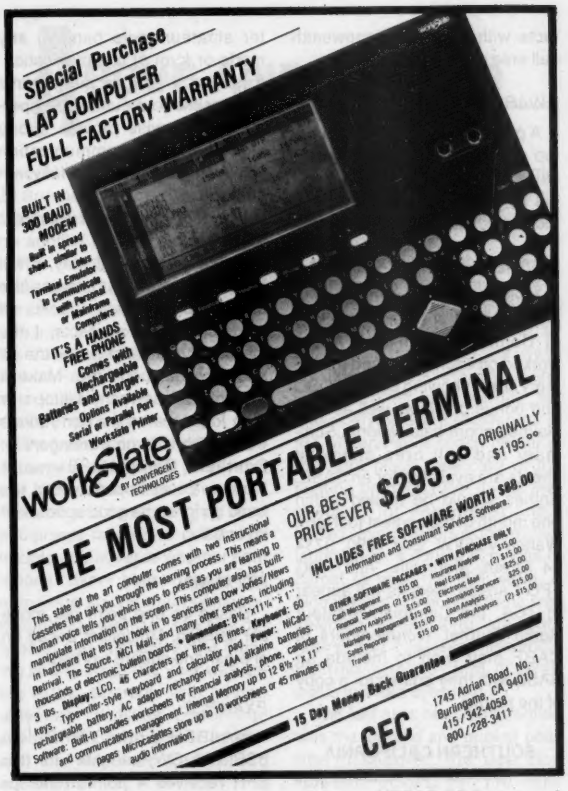


Fig. 7. FLLBS, component placement.



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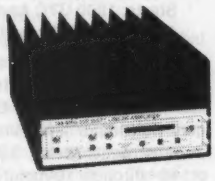

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quency close to the required frequency until the vco is synchronized. When synchronizing the oscillator, the LED should go out.

To obtain a maximum range of loop synchronization, the vco resonance circuit should be tuned in such a way that the voltmeter shows about 11 V. The above method of aligning should be repeated for all operating bands of the synthesizer.

Other Applications of FLLBS

The FLL band synthesizer described above operates with an interval equal to 1 MHz. In case it is used for oscillator stabilization with a different frequency interval, the frequency F_t should be selected accordingly. For instance, in a generator operating with an interval equal to 500 kHz, the frequency F_t should be reduced at output 3 of IC3 from 200 kHz to 100 kHz (IC2 should be changed so that it could divide by ten). No other change is needed.

When the FLLBS is used for oscillator stabilization in the already-constructed equipment, besides choosing the correct frequency, F_t, a varicap diode should be built into the existing oscillator through the correct padding capacity and the resonance circuits should be tuned into the loop synchronization range. The loop synchronization range depends on changes in the capacity of the varicap diode and the value of the padding capacitor, C15.

A capacitor with a relatively low capacity was used here to make impossible any accidental synchronization of the vco with the frequency different by ±1 MHz from the desired frequency. The operation of the vco and its synchronization were tested up to about 60 MHz; synchronization was correct within the whole range. If we want to use the FLLBS for operation at higher frequencies than 60 MHz, IC4 should be replaced with a fast-series IC. Capacitor C15 should be reduced and the vco resonance circuits should be selected and tuned; no other changes are necessary. ■

Parts list

Component	Value	Quantity	Component	Value	Quantity
R1	1.8k	1	C4, 5, 21	4.7k	3
R2	560	1	C6, 7	4.7 uF	2
R3, 24, 25	220	3	C8	0.22 uF	1
R4, 5	300k	2	C9, 10	6.8k	2
R6, 7, 19	22k	3	C11	2.2 uF	1
R8	4.7 Meg	1	C12	1 uF	1
R9	680k	1	C13, 17	1k	2
R10	56k	1	C15, 22	10 pF	2
R11	2.2k	1	C16	18 pF	1
R12	1k	1	C18	27 pF	1
R13, 22	68k	2	C19	33 pF	1
R14	270	1	C23	47 pF	1
R15	30k	1	C24	100 pF	1
R16, 17	10k	2	C25	0.1 uF	1
R18	510	1	Q1, 2, 6	2N2369A	3
R20	47k	1	Q3	2N2907	1
R21, 23	330	2	Q4, 5	2N3819	2
R26	120k	1	D1, 2	1N4148	2
R27	680	1	D4	ZC826	1
L1	100 uH	1	D3	LED	1
Y1	1.0 MHz	1	IC1	SN7400	1
C1	10–60 pF var.	1	IC2	SN7490	1
			IC3	SN7474	1
C2	20 pF if needed	1	IC4	SN74LS90	1
			IC5	LF356	1
C3, 14, 20	47k	3	IC6	SN74123	1

CONTESTS

Robert W. Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONNECTICUT QSO PARTY
Starts: 2300 UTC April 5
Ends: 1900 UTC April 6

Sponsored by the Candlewood ARA, there is a required rest period from 0500 to 1300 on April 6th. Phone and CW are to be considered the same contest.

EXCHANGE:

RS(T), QSO number, ARRL section or CT county.

FRENQUENCIES:

Phone—3.927, 7.250, 14.296, 21.370, 28.540.
CW—40 kHz from low end.
Novice—3.725, 7.125, 21.125, 28.125.

SCORING:

Club station W1QI counts 5 points, Novice QSOs count 2 points, OSCAR QSOs count 3 points, others 1 point each. CT stations multiply QSO points by ARRL sections worked. CT stations may work DX stations for QSO points and only one multiplier, multiply QSOs by number of ARRL sections worked plus one DX country. Others, multiply QSO points by number of CT counties worked.

ENTRIES:

Include an SASE for results and mail entries by April 30th, addressed to: CARA c/o R. Dillion N2EFA, RFD #7, Noel Court, Brewster, N.Y. 10509.

CARF PHONE COMMONWEALTH CONTEST
Starts: 1200 UTC April 12
Ends: 1200 UTC April 13

This contest is open to amateurs in all countries of the Commonwealth of Nations. Entrants may work other amateurs in the Commonwealth using SSB only, on 80- through 10-meter bands. Work only stations outside your own call area. Each station may be worked once on each band. Entry classes include single-operator stations in all or single-band classes.

EXCHANGE:

RS report and a consecutive serial number, starting with 001.

FREQUENCIES:

3.600, 3.760, 7.080, 14.130, 21.200, 28.480 plus or minus 20 kHz.

SCORING:

Each completed contact will score 5 points. In addition, a bonus of 20 points may be claimed for the first, second, and third contacts with each Commonwealth call area on each band.

AWARDS:

A plaque will be awarded to the top scoring allband entry. Certificates will be awarded to top scorers in each class in each Commonwealth call area.

ENTRIES:

A valid entry must include log sheets, dupe sheets, a checklist of Commonwealth Call Areas worked on each band, and a summary sheet showing claimed QSO and bonus points as well as final claimed score calculations. Summary and call area checklist sheets are available for an SASE. Entries should be mailed within one month of the contest to: Norm Waltho VE6VW, Box 1890, 9714 94 Street, Morinville, Alta, T0G 1PG Canada. Results will appear in *TCA*, the Canadian Amateur Radio Journal. Nonmembers of CARF may wish to include an SASE with their entries for a copy of the results.

SOUTHERN CALIFORNIA SIX-METER CLUB QSO PARTY
Starts: 1200 PDT May 10
Ends: 1200 PDT May 11

The purpose of this contest is to generate and maintain a maximum of activity on the six-meter amateur radio band in any mode or form of communication. It is also to get as many hams as possible to mountaintop operate or otherwise provide strong signals for intercommunication within our area and, hopefully, nationwide.

If a good number of six-meter hams get out and on hilltops on the 10th and 11th of May, it will be quite a showing. Imagine the signals and signal reports of cross-confirmed contacts. Let's all get out or at least get on the air and have a good time. Make it a picnic on as many hilltops or high locations as we can radiate from. With a large contingent of Southern California six-meter hams we will hopefully stir the band up for some good sporadic E layer DX.

SCORING:

Based on one point per mode per callsign. Multipliers based on one per grid square worked.

EXAMPLE:

WA6BFH works N6FSL on SSB, FM, CW, and AM—for this BFH receives 4 points (one for each mode worked), also one multiplier for working grid square DM13. If BFH works K6GSX on all the same modes, he will receive four more points and one multiplier for working grid square DM03.

Key Clucks

NEWSLETTER OF THE MONTH

If you were asked to come up with a name for the Chicken Fat Organization's newsletter, what would it be? *Key Clucks*, of course! (CFO is a loose group of high-speed CW fanatics.) Editor Wayne Renard NZ4W carries the poultry theme to extremes; nearly every page of this newsletter has some sort of chicken on it.

Beneath the feathers lies a style of writing that made NZ4W famous as editor of the Nashville Radio Society's *Rat's Tale*. Wayne somehow manages to take the dull facts of day-to-day ham radio and turn them into hilarious stories. *Key Clucks* is proof that club newsletters can be informative *and* fun.

To enter your club's publication in *73*'s Newsletter of the Month Contest, send it to *73* Magazine, WGE Center, Peterborough NH 03458, Attn: Newsletter of the Month.

CALENDAR

Apr 5–6	**Connecticut QSO Party**
Apr 12–13	**CARF Commonwealth Phone Contest**
Apr 14	**ARRL 144-MHz Sprint**
Apr 22	**ARRL 220-MHz Sprint**
Apr 30	**ARRL 432-MHz Sprint**
May 3–4	**Florida QSO Party**
May 8	**ARRL 1296-MHz Sprint**
May 17	**ARRL 50-MHz Sprint**
May 17–19	**Michigan QSO Party**
May 27–29	**CLARA AC/DC Mystery Contest**
May 31–Jun 1	**National 6-Meter Invit. Net Activity Day Contest**
Jun 7–8	**ARRL VHF QSO Party**
Jun 28–29	**ARRL Field Day**
Jul 1	**CARF Canada Day Contest**
Jul 12–13	**IARU Radiosport Championship**
Aug 2–3	**ARRL UHF Contest**
Aug 16–17	**New Jersey QSO Party**
Sep 13–14	**ARRL VHF QSO Party**
Oct 11–12	**Rio CW DX Party**
Nov 1–2	**ARRL Sweepstakes—CW**
Nov 15–16	**ARRL Sweepstakes—Phone**
Dec 5–7	**ARRL 160-Meter Contest**
Dec 13–14	**ARRL 10-Meter Contest**

ABOVE AND BEYOND

Peter H. Putman KT2B
84 Burnham Road
Morris Plains NJ 07950

This month's column is somewhat anecdotal. It pertains to all the careful plans that contesters put together for the big one—the January ARRL VHF Sweepstakes—and how, despite your best intentions, Murphy still has plenty of surprises in store!

I've been actively running the January SS for several years now, but have been plagued with all sorts of problems ranging from equipment failures to power line trouble and adverse weather conditions. Every year, despite the numerous station improvements, something "gremlin" rears its ugly head and I'm back to the drawing board. Well, this year was going to be different, with all-new antennas, feedlines, power supplies for the high power amplifiers, and improved transceiving equipment.

I took the perennial line noise problem into account and employed an ICOM 740S with adjustable noise blanker to fight the electric heaters and blankets on 144 MHz. (Believe me, it's no fun trying to copy FM06 through S9+20 dB noise levels!) Not being very active on 50 MHz, I secured the use of an IC-551D for the contest as well as a KLM 7-element beam. The 432 yagi array had been suffering from high swr after heavy rains which I traced to a marginal pigtail, and replaced with a more weather-tight version. A 220 MHz GaAsFET preamp went up on the tower, courtesy of the VHF Shop. What better way to test a preamp than during a VHF Sweepstakes?

I had earlier installed new runs of Prodelin 7/8" Spir-O-Line on 1296 MHz and also put a surplus Adler Electronics cavity amplifier to use for about 65 to 70 Watts of power. The SSB LT23S 1296-MHz transverter was run through a MMT 144/28 transverter into my Kenwood TS-430S, allowing the use of scanning and memory channels for setting up schedules. New tubes and capacitors went into the 432-MHz power amplifier to improve its reliability and every switch in the station was clearly labeled, for a change. (This latter part is very important, especially when you are frantically jumping from one band to another to make skeds on the UHF bands!)

Having completed the improvements to the station hardware, I turned to creature comforts. My shack is in the basement in an unfinished room, and the walls and floor are concrete. This is fine in the summer on a hot day, but makes an excellent refrigerator in the wintertime! A space heater in the right place took care of the heating problem (yes, it was prechecked for line noise) and I added several layers of foam insulation under a couple of pieces of carpet to keep the feet warm. A nice wooden chair with arms was selected for the long late night hours, and I installed low-angle lighting with 25- and 40-Watt bulbs to avoid eyestrain.

The last area needing attention was the logging and duping position. I secured the use of a Hewlett-Packard HP 110 minicomputer with companion disk drive and printer from Charlie Rothschild WB2INB. Charlie has developed a very nice logging and duping program that runs on HP and IBM/IBM-compatible systems, and our club group SCORE has used it many times during our multi-multi contest efforts. The 110 uses an LCD screen and is well engineered for human comfort while typing. The computer was set up next to the main 144- and 50-MHz stations, with the printer and disk drive on the side table for duping and backing up the memory during breaks.

The addition of a footswitch and selector to assign it to the three main transceivers allowed me to remain in one position. The output of the sequencer box also went to a four-position switch to key the 220, 432, 432 tube, and 1296 power amplifiers—again, all at the flick of a switch. Of course, the transverters on the TS-430 could be switched from 220 to 432 or 1296 through a selector panel, as could the CW keyer! My final act of laziness was to install another rotor with the 50-MHz beam and a second 32-19 Boomer for 144 MHz. This way, I could jump 180° at the flick of a coax switch to work stations calling me off the back of my primary antenna. (This isn't a new trick. Steve WB2WIK and others have used it for years. If you've got a few extra dollars and the tower space, it makes your 2-meter contact rate stay up there!) These modifications completed the upgrade of my station to make it contest ready.

Finally, all was ready. I'd booked the date in my calendar and the XYL made sure we had no plans for the weekend. (We actually did, except we didn't know it at the time. More on this in a moment!) The appointed hour rolled around on Saturday and at 2 pm KT2B was on the air on 50 MHz with 80 Watts.

It became apparent quickly that my 6-meter station wasn't going to make a big splash in the contest. Sure, the 80 Watts and the 7LD beam worked fine, but anything over 100 miles away was going to be VERY hard to work. The beam was installed at 30 feet, which is hardly optimum for 6 meters. But it was the only place I could install the beam, so I figured if I could add another 10 to 20 multipliers, it would be worth the trouble.

The IC-551 has a decent receiver but really needs a good preamp in front of it, so out came the JANEL MOSFET preamp that Mike Crawford WA2VUN had loaned me with the rig and beam. Only problem was we had blown out the MOSFET in June of 1984 during the June VHF QSO Party and he neglected to tell me that (or forgot). Out came the soldering iron and a new 3N204, and after a 15-minute delay I was back on the air. Some interesting prefixes were bagged during this period (nothing exotic) and I worked about 35 stations before turning to 2 meters.

Aha! Now this was more like it. The combination of the two Boomers—the main at 45 feet and the second at 35 feet—worked very well. With my 200-Watt MML amplifier (reviewed in March, 1986, *73*) I was able to start piling up the contacts right away. In short order I worked 70 or 80 stations and 10 grids! The 2-meter setup was working better than I had hoped. After several hours here, I broke for dinner and planned to attack the higher bands.

Soon I was back on 50 MHz checking for more new contacts and quickly added about 10 more before some incredible buzz in excess of +30 dB wiped out the front end of the IC-551D. Another electric blanket, probably. I jumped up to 220 MHz to see what was happening and fired off a few more contacts and grid squares—among them my first ever contact with FM28 on 220 MHz. We quickly jumped up to 432 to duplicate the contact, then to 144, and finally 1296 MHz (no luck). No matter! The station was really hopping now. I was finally appreciating all those hours of hard work during the summer and fall! 432 yielded more contacts and grids, including several in Maryland and southern Virginia. 1296 was even more fruitful with contacts into Maryland and northern Virginia. A quick check back on 144 MHz yielded many more contacts as stations wandered onto the band.

I took another quick break at 10 pm and went upstairs to grab a snack. My wife was looking a little funny and mentioned that she was having mild cramping sensations that evening. Unusual? Not if she's eight months pregnant. It seemed too early to be thinking of a baby! I had this strange sense of impending doom but shrugged it off and went back to work.

By now I was bouncing back and forth between 144 MHz and 1296 MHz (10 to 11 pm is the 1296-MHz activity hour in these parts) and working lots of stations. The total contacts were well over 200 and the grids in excess of 40 on all five bands. Not bad for 300 Watts on 144 and 432, 100 Watts on 50, and 220 on 70 Watts on 1296.

Activity tapered off on the higher bands so I went back to work on 50 and 144 MHz until about 2 am, when I decided to call it a night and get a few hours shuteye. I had made 250 contacts and 52 grids—decidedly better than my previous year's totals at the halfway point. In fact, I was running about double last year's score and well expected to break 500+ QSOs and 80 grids.

I knew I was in trouble when I came up to the bedroom and my wife was bent over on all fours on the bed, breathing slowly and looking at the clock. You guessed it! Her contractions had started and she was into active labor! I especially liked her comment as I came through the door: "I don't think you'll be going back on the air again this weekend!" To make a long story short, she indeed did wind up going to the hospital the next morning and by 5 pm we had ourselves a healthy 6-pound 5-ounce boy, three weeks early, and I'm sure it was because of my carefully laid contest plans! As she was wheeled into her hospital room, I pondered the meaning of it all. This had to be Murphy's

biggest prank ever, after all the blown GaAsFETs, shorted power supplies, and constant line noise. He's a resourceful guy! Makes you really respect him as an opponent. (And no, I didn't name my boy after him!)

As 8 pm rolled around, there was nothing left to do but go home, as Gayle was tucked away safely in her hospital bed, while Ross Lewis Putman was the subject of much admiration and attention of the nurses. Feeling like a fifth wheel, I was about to leave when my shocked ears heard my wife say "Gee, there's still a few hours left in the contest. Why don't you go home and operate them? It might relax you!" She had a point. Even though I hadn't had any sleep since early Saturday morning, the adrenalin was flowing like the mighty Mississippi. What the heck! A quick stop at Burger King, and I was home again, warming up the rigs.

News spread fast, especially when you've got guys like Steve Katz WB2WIK and Ivars Lauzums KC2PX in your contest club. I think every fifth contact included a "Congratulations, Dad!" with the grid exchange, not to mention a few expressions of surprise that I had actually bothered to get back on the air. Well, you just can't keep a contester down, and at 11 pm I pulled the plug with 290 QSOs and 58 grids for my efforts. It wasn't what I was hoping for, but I'll take it. . .

AM-6155 update: Well, Fair Radio is still out of stock on AM-6155s but is now getting rid of their AM-6154s at a fast rate. Many readers have called with questions on how to modify these radios for 2-meter operation! As they come from the box, they will tune the 144–148-MHz band, although you'll only see about 50–60 Watts out for 10 Watts of drive. I do not have any specific information on modifying this unit and would welcome it from readers who have done the mods. A suggestion might be to work from the 144-MHz mods to the AM-6155 from last month's column, as the plunger is reset on the 6155 to get 2-meter operation. The plunger on the 6154 is already set for it, so the grid compartment will have to be tweaked up. Basically, there are three places that will require attention: C1, the input coupling capacitor needs to be increased in value to about 10 pF. C2 and C3 will also have to be increased to about 30 pF and 100 pF respectively. (Refer to the schematic in the March column.) The existing output tuning circuits need not be modified to result in about 300–500 Watts with 1–10 Watts of drive, depending on how tightly you couple the input.

Again, I could use input from you readers. Send along your schematics and notes and I'll publish them posthaste. Incidentally, I ordered one of the #A5-TUN-CAV assemblies from Fair Radio and it showed up today, so I'll give a brief report on what I've found out so far: The unit does contain a 4CX250B and also contains a type 6816 tube, which won't be used. The input connector is a type SMA, and the hole it's in can be drilled out to take a BNC or N connector. The ouptut is type BNC and can be left alone. There are several adjustments, including a "PA FREQ ADJ" control, which resonates the cavity, and an output coupling control next to the tube using a flapper. The output of the 6816 also has a tuning control which could be used to resonate the grid of the 4CX250B.

Some kind of input grid circuit will have to be made up and I'll pass along my notes on this as I proceed. Although there is a hole marked "VHF-UHF PA BAND SWITCH," there is nothing in it so the cavity is tuned for one band range. I'll determine that also by the next column, but most likely it's set up for around 200 MHz. This unit also needs a blower and power supply voltages of +2000 VDC, +360 VDC, -135 adjustable VDC and 6.0 VAC for filaments. This might turn out to be a nice amplifier assembly, especially if you've got the power supply already built up. A single 4CX250B on 220 MHz should be good for around 300–400 Watts output with 2–6 Watts of drive. The cavity might also make a good repeater amplifier. The cavity design lends itself to a HI-Q tuned circuit, important in repeater installations to avoid desense. And 4CX250's are rugged and easily replaced. You can often find them at flea markets for as low as $10 apiece. Contrast that with 8930's which retail brand new for over $130!

READER INPUT DEPT.: Aside from the usual letters asking for more information on Fair Radio Amplifiers, I get newsletters from radio clubs. One of the strangest and funniest I've seen comes from the Pittsburg Repeater Organization and is called (appropriately) the PRO-Crastinator. Published by KC0ES, George Willard, it's a loose collection of local news, excerpts from the W5YI Report, and some funny articles on topics of general interest. This month's deals with the absurdities of mathematics in which the author proves that among other things, everything is white, and Alexander the Great did not exist while having an infinite number of limbs. What does this have to do with amateur radio? Beats me but I laughed pretty hard when reading the newsletter.

The Southern California Six Meter Club is sponsoring the Southern California Six Meter QSO Party on May 10 and 11. The purpose is to generate and maintain high activity levels on the six-meter band using any mode of communication. It runs from noon till noon PST, and entry forms are available from the club. Write them at: PO Box 448, Cypress CA 90630.

In future columns, I'll be discussing power measurements and tackle the subject of swr and what it means to you on the VHF and UHF bands. I'm also working on getting one each of the IC-471 and TS-811 multimodes for a side-by-side comparison in the lab. Many users of the 432-MHz band want full coverage of 430–450 MHz with the ability to work SSB, CW, and FM repeaters, as well as the OSCAR uplink. These rigs are full-featured and both will set you back a nice big piece of change. How well do they really work? Are they worth the investment? I'll try to have both qualitative and quantitative answers for you in the next few months.

Look for reviews of the new EME VHF/UHF wattmeters from Germany, including multiband models with coverage from 144 MHz all the way up to 2304 MHz. Also, more new transverters from Microwave Modules and SSB Electronics, as well as the Microwave Modules ATV transmitting and receiving converters. There're plenty of products out there for the VHF/UHF enthusiast and I'll try my best to have a look at as many as I can get for you. If you're out at Dayton this year, why not stop by the PX Shack booth and we'll have an eyeball QSO! Until next month, see you above and beyond!

RTTY LOOP

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6 Jenny Lane
Pikesville MD 21208

I don't do this often, but in the spirit of this month's holiday, I hope you'll bear with me.

In the beginning, the Teletype Corp. created the Model 12, and it was good. Next came the Model 14, and it was good. Then came the Model 15, and it, also, was good. Soon thereafter came the Model 19, and it was *very* good. And then came the Model 28, and it was *very* good, indeed! But then came the Model 33, and it was the best yet. Ouch!

Well, you get the idea. Here I am with notes from many of you about the Teletype Model 33. Major Gene Pfeiffer of New York asks to be counted in, "at least 10 votes. I would like to do away with all unnecessary components . . . all I need to know is where I can cut in the external loop to drive the keyboard."

Louis Hutton K7YZZ of Bellevue WA is another ham who has tried to hook up a Model 33 to a computer. He has "been able to successfully modify the TTY to run from TTL ouput signals from the CoCo's serial I/O port. But like anything you try, there are problems."

Down south, Bob Furlong WD0CBN in Miami FL would like to hook up his Model 33 to use as a slave printer for his setup. He cautioned me in his letter that he has only "put together Heathkit projects and simple one-tube receivers, but I will give anything a try." That's the spirit, Bob!

Ted Malafouris W9OVZ in Howell MI has used some of the information presented here before to hook up his Model 33 to a receiver, but says that all he prints is "garbage." Well, Ted, I'd like to remind you that the 33 is an ASCII-encoded machine, and most amateur transmissions remain Murray (5-level) encoded. Also, there is

tremendous variation in what FSK signals you'll encounter when tuning across the HF spectrum. Don't be discouraged—hopefully some of the material presented this month will help.

Andrew Janer WA1VRZ in East Haven CT is an ambitious soul who hopes to hook up a Model 33 to a Timex computer. We aim to please, sir.

The Teletype Model 33 teleprinter is either an electromechanical marvel or a nightmare, depending on how you look at it. Using a typing cylinder, kind of a "squooshed" Selectric ball, it chugged along at 110 baud—equivalent to 100 words per minute, ASCII code, uppercase only with a "Teletype standard" 72-character line length. Despite these limitations, many of these monsters found their way into amateur radio stations.

Interfacing the Model 33 is made difficult by the fact that there is no single standard version of the 33, but a variety of options contained in a panel on the right side of the machine, the Call Control Unit (CCU). Various CCUs were manufactured (the Model 33 is not out of production) for line service and telephone systems, as well as for computer interfacing. If you can get it, the I/O 33 is the easiest of all to interface. This CCU is identified by six push switches along the front of the CCU labeled MOTOR OFF, REMOTE, REQUEST, EOM, LOCAL, and PUNCH. Usually, that is...you see, there are different ones, too. And you can't always tell a CCU by its buttons.

Anyway, if you have one of those, you'll find a terminal strip inside, at the rear of the CCU. On mine, it was mounted vertically under the bank of Molex® connectors. On yours, who knows? If you have one like mine, connect the brown/yellow and white/blue wires to terminal 5, and the violet wire to terminal 9, and move the blue wire from the 750-Ohm tap to the 1450-Ohm tap on the power resistor behind the power supply inside the teleprinter. Then connect the interface through the connections shown in Fig. 1, after first checking for unwanted voltages and the like.

If you're a trifle less than brave, as I am (not), you might be interested in the circuit of Fig. 2. This is a scheme to use an optoisolator, such as a 4N35, to isolate the computer or interface from the deadly voltages that may be lurking around the Model 33. I highly recommend such isolation.

Let's say that you have one of those Model 33s that isn't equipped with an I/O CCU, now what? Well, you still should have the terminal strip, often labeled 151411, at the rear. If you lack that, trace out the wires coming from the selector magnets. They should enter a printed circuit board, the Selector Magnet Driver board. Pin 6 from this board should be ground; pin 11 is the signal input.

The wire going to pin 11, by the way, should be coming from the transmitter distributor. That means the keyboard signal should be available there. Again, if you have a custom-wired 33, all bets are off, but you should be able to trace out the wiring and go from there.

Assuming you have been able to identify the proper leads to connect to, and have interfaced the 20 mA TTY loop with the more

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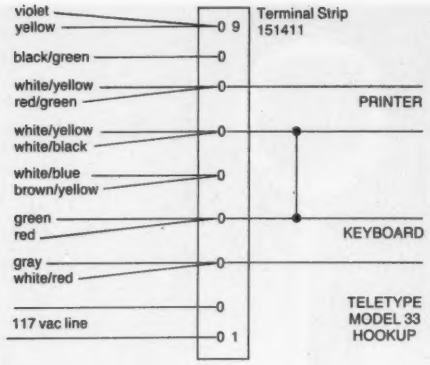


Fig. 1.

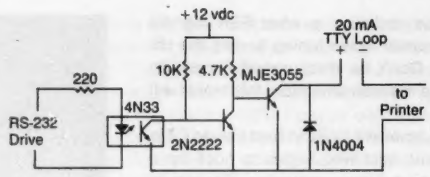


Fig. 2.

common RS-232 levels of a computer interface, all that is left to do is make the computer speak 110 baud of ASCII. The ASCII part should be easy; it's the native language of most computers. As to the 110, it depends on the computer. We covered the CoCo in this column several months ago. Program 1 is a simple scheme to allow the CoCo to output at 110 baud through the "bit banger" serial port on the rear apron. Similar schemes should be just as easy for other computers. Even my old 6800 would slow down with the flick of a jumper.

I hope this material will help those of you who have been trying to get a Teletype Model 33 interfaced. Remember to measure all points for dangerous voltages *before* you hook up the computer. I don't mean you should take the "smoke test" literally! And please, let me know your experiences.

Moving right along . . . I have asked for some opinions, now and then, on a variety of RTTY topics. One of them has been packet radio. Are you interested, or will this be the NBVM (who remembers that one) of the future?

Wendell Larsen W3IRX of Upper Black Eddy PA has taken the challenge. Wendell says that he is "currently on HF and VHF RTTY with an IBM PC and Hamcom software" and has been contemplating getting on packet. No one yet has satisfactorily clarified his questions about this mode.

Wendell writes, "Essentially, what does it provide to justify the cost? Supposedly, it will enable countrywide 2-meter digital communication capability. I question this since it appears difficult, if not impossible, to establish effective links, at any time, even on the East Coast. I really can't see how error-free communication is possible if the link cannot be established.

"Now, packet operation on HF may hold some possibilities for point to point without intervening digi-peaters. I'm constantly hearing local 2-meter packeteers enthusiastically proclaim that they made it as far as New York or Florida. Even then, the path was so cluttered that nothing practical could be accomplished."

Well, Wendell, from the packeteers I've talked to, it sounds like we are looking at two different systems! I don't know what the closest digi-peater is in Upper Black Eddy PA but here in Baltimore establishing a link with a machine doesn't seem to be much of a problem. Now, I grant you, what hams talk about on packet is not likely to be any more stimulating than what hams talk about on RTTY, FM, SSB, AM, or CW. I am leaving ATV and SSTV out of this because they at least have pictures.

But the mode itself promises great potential, with the proliferation of digi-peaters. I think back to my early days on 2 meters. On AM, getting a signal from Silver Spring MD, a suburb of Washington DC, into "the District," (as residents term DC) was a real thrill. When the first FM repeater was established midway between Baltimore and Washington, I drove to a hill near my home to try to make the repeater, and with it, Baltimore. Now, 2 meter repeaters are so common that sitting here in my den I can pick up a handheld two-meter rig and trigger five or more machines, with a geographic range of Washington DC to York PA.

This is the ground floor of packet'dom. If it takes off, it won't be for present convenience, but for future promise. Let's hear what others have to say on the subject. We all would like to know.

Regards to David Berger WD6EUC of Sunnymead CA. David has joined the ranks of C-64 owners, and is looking for a way to put his computer onto RTTY. Well, David, I hope the review of C-64 and VIC-20 software covered here a few months ago was a help to you. I also suggest that you ask around at your local ham club for someone who uses this setup. The C-64 is a popular small computer, and I am sure that you'll find someone in your area who is using it on RTTY. Let me know how you make out.

Another fan, Jerry Valentini KC2IO of Jersey City NJ is running a TRS-80 CoCo, and is looking for a disk-based program to run RTTY. Well, sorry to say, Jerry, not much is available commercially at this time. A scheme was presented here a few months ago to convert Clay Abrams' program, NEWRTYCW, to at least load from disk, and I have sent that along to you. Hope it helps.

Jerry also asked about keyboard replacements, a topic that I have addressed for several computers. Well, if you can find it, the fabled $5 Radio Shack replacement keyboard certainly represents the best value per dollar ratio. You can identify it by the red BREAK/ESC key in the upper right corner, an ALT key next to the Q, a CTRL key next to the A, the CLEAR key next to the @, and the cursor arrows relocated to a diamond configuration on the right side of the keyboard. It also sports two function keys, labeled F1 and F2, at the lower right. If you can't find that one at Radio Shack, don't buy any of the other Radio Shack keyboards; they were made for a variety of other computers, and won't fit the CoCo.

Instead, you'll have to choose from the $5 keyboard being sold at a higher price, as advertised by several national advertisers, or one of the "expensive" keyboards that cost more than $50. At that point, it really becomes a matter of personal preference. To get a feel for typing on one, see if anyone near you owns any of the replacements. Good luck.

As you can tell, many of the folks writing in this month were helped by material presented in this column in the past. Many of the more requested topics are in the reprint series I have put together. A list of reprints, each of which is available for a self-addressed stamped and $2 to cover costs, can be had for the SASE alone. Just send it to me at the address at the top of this column, and ask for the list of available reprints. I always welcome questions, of course, and try to answer them in the column as soon as possible. If you want a personal response, be sure to include that all-important SASE. I can also be reached on CompuServe, ppn 75036,2501, either on EasyPlex or often on the CoCo SIG (GO COCO).

Topics are flying by these days, and next month promises to be a winner. Be sure your subscription to *73* is up to date; you wouldn't want to miss next month's RTTY Loop!

```
10 ' 110 BAUD OUTPUT THROUGH
20 ' COCO SERIAL PORT
30 ' RTTY LOOP—APRIL 1986
40 ' MARC I. LEAVEY, M.D. WA3AJR
50 POKE &H954,&HO1:POKE &H96,&HF6:'110 BAUDS
60 POKE &HFF23,&H30:' THESE POKES
70 POKE &HFF22,&HF9:' DISABLE THE
80 POKE &HFF23,&H34:' PRINTER HIGH
90 POKE &HFF22,&HOO:' SIGNAL REQUIREMENT
100 END
```

Program Listing 1.

REVIEW

SSB ELECTRONICS PA2310 POWER AMPLIFIER

SSB Electronics of Iserlohn, Germany, is an up-and-coming manufacturer of many quality products for VHF and UHF enthusiasts. The company also offers a full complement of receive converters, transmit converters, transverters, and amplifiers for microwave enthusiasts. The PA2310 is a solid-state amplifier for the range of 150–1300 MHz, which operates from 13.8 volts and allows SSB, FM, or ATV operation.

Ordinarily, a low-power monoband UHF amplifier might not warrant much attention; however, there are very few available in the medium-power range for 23 centimeters. There are several transverters on the market for this band, but most of them are limited to 1 to 3 Watts output. The PA2310 complements those transverters, especially since it requires only 500 to 750 mW of power to attain full output.

Another reason it's handy to have 10 Watts of power here is that most outboard high-power 23 cm amplifiers utilize 2C39/7289/3CX100 type tubes, operating in grounded grid configuration. These amplifiers are usually good for 10 dB of gain in this mode, so 10 Watts of drive will usually yield 100 Watts or so of output. Use two of these tubes and you'll see close to 200 Watts output. The PA2310 fills the gap nicely as an intermediate driver stage, so you will see 100 Watts or more of output instead of 10 to 15 Watts using just the transverter.

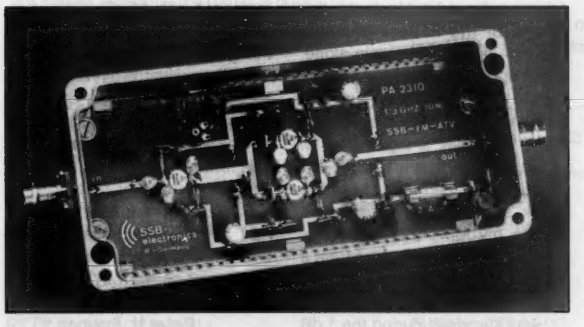
The photo shows the unit with its cover off. The circuit is simple and employs three type BLU90's—one as a driver and two as finals. The output circuit is the usual etched microstrip type. Bias is set by the pot in the upper left corner. Note that there is no provision for standby operation, although you could incorporate it if needed. The amplifier operates in grounded-emitter mode and gain is typically on the order of 6–7 dB per stage.

SSB Electronics rates its amplifiers at 14.5 V dc, which is apparently common practice in Europe. How did this model do? With a Bird Model 43 Wattmeter and 25G slug (25 Watt, 1.1–1.8 GHz), I measured exactly 10 Watts output across a Termaline 50-Ohm dummy load. The driving source was a Microwave Modules MMT 1296/144, which was throttled back to about 500 mW output; the source voltage was 13.8 volts. Raising that voltage to 14.5 volts resulted in about 12 Watts of output power. Lowering the voltage to 12.5 volts dropped the output to 8 Watts.

In actual operation, I used this amplifier on Slide Mountain in June of 1985 with the MMT 1296/144. Our power source was a motorcycle battery, which started out at almost 14 volts and dropped to about 13 volts when we concluded our operation. The amplifier ran cool at all times. The heat sink should be adequate for 1296 ATV operation; however, I'd recommend reducing the drive and keeping the output power at 8 Watts or so in this mode. Note that the BLU90 transistors aren't swr protected, and there is no ALC circuit in the output. You must take caution not to load them into an swr of 2:1 or greater—otherwise, you might be waiting a bit for replacements from Germany. (At this time, there are no sources for this device in the United States.)

In my home station, I mounted a Dow-Key 12-volt coaxial relay atop the amplifier chassis. This amplifier switches the antenna lead from amplifier to transverter antenna input and also turns the dc power on and off to the PA2310. Again, some sort of switchable bias could be used and would accomplish the same thing.

All in all, the PA2310 is an excellent medium-power, reasonably priced amplifier for 23 cm. *Price: $300; U.S. distributor: The VHF Shop, 16 S. Mountain Blvd., Mountaintop PA 18707.*



The PA2310 solid-state amplifier with its cover removed.

55-ELEMENT ANTENNA FROM TONNA

Now that you've got some power on 1296 MHz, you'll need a good antenna to make the most of it. Along comes Antennes Tonna of France with a new wrinkle for 23 cm: a 55-element long-boom yagi. The boom is 15-feet, three-inches long and the manufacturer claims 21.25 dB gain over an isotropic dipole. Now, that's a lot of antenna!

The antenna comes completely disassembled with the various elements and holders in separate packages, unlike the 432 Tonna yagis that come largely assembled. But don't let the apparent complexity of the antenna scare you: Tonna has carefully color-coded the ends of the various elements so you can tell them apart. The elements themselves are made from #10 enameled wire that is filed flat but still quite sharp, so be careful. Select the elements by their color and push them through the one-piece molded element holders. You'll need a ruler, preferably one with a metric scale, to center the elements.

I have assembled two of these antennas and they both took about 2 hours of careful work from start to finish. Tonna includes an extra element in case you bend or break one. This extra element is as long as the reflector. As with all Tonna antennas, the drive element is a sealed dipole with a supplied RG-213 pigtail. On every Tonna antenna I've ever used (and that includes five 432 MHz 21-element yagis and four 1296 MHz 23-element types) the dipole-driven element exhibits better than a 1.2:1 match in the desired bandwidth. Not only is this an excellent matching system, but it's also very durable. There are no mechanical joints to corrode or work loose, and I wonder why more manufacturers don't use it.

You'll notice that the antenna comes with two boom braces. One problem with 23 cm yagis (and higher frequency yagis) is that the antenna mast support usually is a significant portion of the element length, and a 2-inch mast in front of one of these directors detunes the antenna quite nicely. Tonna recommends either mounting the antenna on top of a mast section, or using an outboard sidearm with the boom attached to the mast at its end. Since the elements stand off from the boom, mounting the boom at mast end ensures that the elements are sufficiently clear of the boom and mast. The top clamp makes this attachment, and the second, lower brace and clamp serves to level the entire antenna. As you might expect, the boom exhibits a bit of sag.

Once the antenna is assembled, you will probably have to break the boom at least in half to get it out of the door! I forgot the boom length and assembled the antenna inside forgetting that my door wouldn't allow the clearance to get it out!

The next order of business was to verify the claimed gain spec. Steve Katz WB2WIK of *CQ* magazine also received one of these monsters for evaluation, and he suggested we pool our efforts to set up a test range in which the gain figures could be verified. Steve did some research and came up with a formula from the publication "Technique of Microwave Measurements," from the M.I.T. Radiation Laboratory

$$G^2 = \left(\frac{4\pi R}{\lambda}\right)^2 \frac{Pr}{Pt} \quad \text{OR} \quad G = \frac{4\pi R}{\lambda} \sqrt{\frac{Pr}{Pt}}$$

G = Gain expressed arithmetically (not in dB)
λ = Free space wavelength in units
R = Range of separation of antennas in same units λ

Fig. 1. Formula for calculating gain of either of two identical yagis.

Fig. 2. The nomograph for the H-plane of the antenna.

series. The formula calculates the gain using two identical antennas that are a known distance apart. The formula is given in Fig. 1. Basically, all you need are two of the same yagi antennas and the ability to measure the distance between the two, as well as the power delivered to one antenna and the received signal from the other.

We set up the two 55-element yagis so that the front-most directors on each yagi faced each other at a distance of 75 feet (100 wavelengths at 1296 MHz). Using a Kenwood TR-9000 and SSB Electronics LT23S Transverter as a signal source, a Bird 43 wattmeter was put in the line right at the RG-213 pigtail, meaning it was about 1.5 feet from the dipole-driven element. At the receiving antenna, we mounted a Boonton 92 rf millivoltmeter with 50-Ohm probe and lots of Bunji cords. The power output was set at 5 Watts on the Bird 43 and allowed to stabilize for a few minutes. The rf millivoltmeter was also warmed up and set to the +20dBm range. Steve then swung the receive antenna back and forth slightly to peak the indicated output. At this point, the measurement taken from the millivoltmeter was +13.5 dBm (22.4 mW).

Plugging this into the formula resulted in a figure of 265.98 for both antennas. One antenna would exhibit 3 dB less, or half the gain: 132.99. Expressing this number as gain in dB would be 10 $\log_{10}$ 132.99, or 21.24 db. The manufacturer claims 21.25 db. Close enough for you? I would assume from this that Tonna's gain figures probably aren't overrated.

The pattern is very sharp. Fig. 2 gives the nomograph for the H-plan of the antenna. The 3 dB beamwidth is claimed to be about 11 degrees. The nomograph and our experiments would bear this out. The 55 element F9FT is a sharp antenna, and while it exhibits a considerable amount of forward gain, the sharpness of the pattern might make it unwieldy for the average 23 cm operator. Still, if you understand the antenna and its advantages and disadvantages, it can make the difference for your 1296 MHz station. For example, the K3YTL contest group used eight of these during the recent September VHF QSO Party and worked 65 stations on 23 cm. It definitely works!

The Tonna 55-element antenna costs $70. *US Importer: VHF Shop, 16 S. Mountain Blvd., Mountaintop PA 18707.*

Peter H. Putman KT2B
Morris Plains NJ

MV 220 MAST MOUNTED GaAsFET 220-MHz PREAMP

SSB Electronics of Iserlohn, Germany, has become the first European manufacturer to come out with a commercially available mast-mounted preamplifier for 220 MHz. The 220 MHz band isn't available to Europeans and this represents an unusual bit of marketing on SSB's part. How much of a demand is there for 220 preamps? Only time will tell, but this is a big step in the right direction.

Based on the popular MV series preamps, the MV 220 is basically a reworking of the MV 144 mast-mount preamp. Employing a single GaAsFET, the manufacturer claims in excess of 16 dB of gain. This is considered a 1 kW through-line switchable preamp, and although the unit has its own rf vox type sensed keying, SSB strongly urges use of its companion sequencer when running high power levels.

I've always admired the rf and watertight cases in which SSB makes their preamps. A small gasket runs around the lip of the cover to keep moisture out. You'll need to make three connections: antenna, transceiver and dc power. As with all SSB preamplifiers, the coaxial relays switch in when power is applied. This protects the GaAsFET in case of power loss, or in the event of strong lightning storms. You just cut the power and it's out of the line.

Threaded studs are attached to the case, so you can bolt the unit directly up to a 2-inch mast. A small piece of tubing and gasket serve to waterproof the dc power connection cable, which you must supply. Installation is simple and takes only minutes. I used this preamp with my existing ARR sequencer for keying, and had no problems with false keying, although water got into one of the pigtails and froze, creating a high swr condition. It made no difference to the preamp as the GaAsFET percolated happily along.

On-air tests were impressive. 220 MHz is a sparsely populated band, and quite often the only signal you hear on it is weak and some distance away. In this case, the preamp makes a big difference, especially on signals with lots of QSB. In many cases, my basic 220 transverter—a "Canadian" Microwave Modules 220-28—couldn't even detect the signals that came up to S3 with the preamp switched in, largely due to the noise figure of the 220 module—around 2–2.5 dB. When working stations with rapid fading or flutter, the difference between hearing the conversation and hearing big gaps filled with noise was this preamplifier.

Okay, so it worked. But how well? Back to the lab: Using Hewlett-Packard test equipment, I measured the gain, minimum discernable signal (MDS) and 1 dB compression point. On-air tests indicated that this preamp had lots of gain, and the measured figure of 23.2 dB at 220.00 MHz certainly confirmed it. No doubt, this is one of the hottest preamps around—if you go by gain alone. What about MDS? In my tests, a signal of −140 dBm was detectable using a 1 Khz bandwidth. Pretty sensitive. A signal level of −130 dBm gave us a 10 dB S+N/N ratio, so it certainly hears the weak signals, not to mention putting my MMT 220 to shame. Well, what can you expect from a MOSFET at 220? A noise figure of 2.0 dB is not shabby.

I was surprised during the 1 dB compression test. This preamp does have lots of gain, and on-air tests indicated that the strong signal from Channel 13 was pumping the preamp adversely. By "pumping," I mean a general hash and splatter of intermod products head up and down the 220 band when my yagi was pointed towards New York City. Without the preamp, these products were unnoticeable. Incidentally, another preamp I use here (ARR 220 VDA) exhibits the same problem, but to a lesser degree. It uses a MOSFET and also has less gain. I didn't get to verify its 1 dB point but the SSB MV 220 came up short at -3.5 dBm out. What this means is that the preamp is likely to have trouble with strong local signals, on adjacent channels (and even on an adjacent TV channel) to the detriment of the weak signal you are trying to hear.

This isn't the first time I've observed a low 1 dB compression point on an SSB product. Another MV 144 preamp exhibited much the same number, but had lots of gain. Perhaps the compromise between gain and compression point still needs to be worked out by the folks in Iserlohn. Incidentally, the gain centers on 225.00 MHz, so this preamp could be employed for weak signal FM work as well on 223.50 with good results. In fact, the preamp still had 10 dB of gain at 210 MHz and 233 MHz—which is pretty broadbanded!

For those with a preponderance of weak signals on 220 to choose from, this preamp might make the difference. If you live close to TV channels 12 or 13, you may find the "pumping" problem to be a bit of a headache, but there is a provision to adjust the gain internally by means of a potentiometer. This pot is located at the input to the preamp and is part of a resistive attenuator network. The total attenuation is on the order of 5 dB. I haven't had a chance to use this control, but would be tempted to replace it with 10 dB of fixed attenuation and run the preamp at a net gain of 13 dB or so, which might help with the overload problem (and also raise the compression point above zero). I'll try to run these tests and report on them in a future "Above and Beyond" column.

SSB Electronics MV 220 GaAsFET Preamplifier, Price Class: $180; US Importer: The VHF Shop, 16 S. Mountain Blvd., Mountaintop PA 18707.

Peter H. Putman KT2B
Morris Plains NJ

FUN!

John Edwards KI2U
PO Box 73
Middle Village NY 11379

PACKETEERING

I have seen the future and it is digital.

After several months of abject poverty, brought about primarily by the purchase of a home satellite TV system, I finally decided to take the plunge and invest in a packet radio terminal node controller (TNC). The result has been the most fun I've had in amateur radio since I gave the local repeater coordinator a hotfoot at the 1978 LIMARC hamfest and flea market.

Packet radio, fellow hams, is going to save our hobby. Don't let anyone else tell you anything different. I will be so bold as to predict that packet will become one of our primary operating modes by the end of this decade. It will certainly overtake CW in number of users and will be a rival to phone operation within a few years. Hams will still use CW for recreational purposes—just as some people occasionally like to ride a horse instead of drive an automobile—but packet is destined to become our primary method of transmitting text information. *Requiescat in pace* CW, RTTY, and AMTOR.

What makes packet communication so wonderful? Well, imagine being able to tie into international computer bulletin boards, to swap error-free messages and programs, and to have your computer send and receive data even when you're away or asleep. Who needs CompuServe, The Source, or those other high-priced on-line information services? Hams will do it better and for free. That is the heritage that has been handed down to us from the radio pioneers.

Packet, thankfully, is also relatively inexpensive. A $150 TNC connected to your existing 2-meter FM ricebox and home computer will put you in business. Heck, I've seen CW keyboards that cost more.

As you may have guessed, this month's questions are about packet radio. For those of you who aren't yet acquainted with the technology, I hope you'll read along. You may pick up some information along the way. As for packet veterans: the future is ours.

QUESTIONS

1) Packet radio sends data one character at a time.
   1) True
   2) False

2) A packet transmission *must* contain only ASCII characters.
   1) True
   2) False

3) A packet length is usually:
   1) 32 characters long
   2) 40 characters long
   3) 80 characters long
   4) 128 characters long

4) When were ASCII data transmissions made legal in the United States?
   1) January, 1970
   2) March, 1975
   3) March, 1980
   4) November, 1983

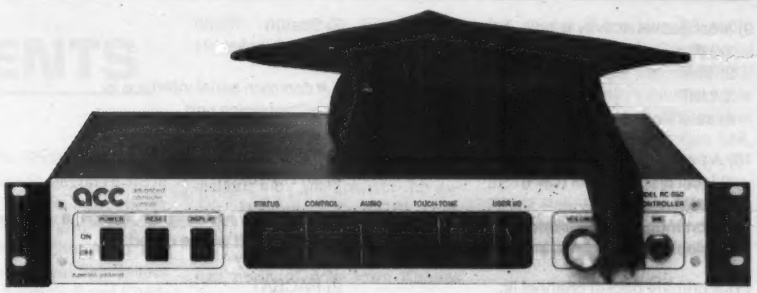
5) What is the maximum allowable baud rate below 28 MHz?
   1) 170 baud
   2) 300 baud
   3) 1,200 baud
   4) 2,400 baud

6) Above 220 MHz?
   1) 1,200 baud
   2) 2,400 baud
   3) 9,600 baud
   4) 56,000 baud

7) Approximately how many TNCs were sold during 1985?
   1) 100
   2) 1,000
   3) 10,000
   4) 100,000

8) Which of the following firms *does not* manufacture a TNC?
   1) Heath
   2) Kantronics
   3) AEA
   4) ICOM

"When You Buy, Say 73"



The RC-850 Repeater Controller just got a whole lot smarter.

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The autopatch now supports remote telephone lines linked by radio, so that you can extend your autopatch coverage to match your RF coverage. You can have autopatch even if you can't get a phone line at your site. The 250 autodial numbers meet the needs of even the largest groups, with up to 35 digit storage for MCI and Sprint.

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9) Most packet activity is on:
1) HF
2) VHF
3) UHF
4) satellites

10) A packet network is a type of:
1) local area network (LAN)
2) database
3) communications protocol
4) telephone packet switching network

11) A primary packet channel is:
1) 146.52 MHz
2) 144.11 MHz
3) 145.01 MHz
4) 21.390 MHz

12) A digipeater is:
1) a dual frequency data repeater
2) a single frequency data repeater
3) illegal below 28 MHz
4) very expensive

13) A packet beacon runs continuously.
1) True
2) False

14) Which of the following *is not* a packet protocol?
1) AF2M
2) AX.25
3) VADCG

15) What city had the first U.S. digipeater?
1) New York
2) San Francisco
3) Boston
4) Los Angeles

16) A common serial interface is:
1) a Centronics port
2) an RX-7
3) hard to find
4) an RS-232C

17) AMSAT is planning to launch a packet radio satellite. It will be called:
1) OSCAR 17
2) PACSAT
3) DIGISAT
4) PACSTAR

18) TERRACON is:
1) another planned packet satellite
2) a ground-based packet linking system
3) a packet-based emergency warning system
4) packet for MARS operators

19) What *is not* useful in a packet beacon transmission?
1) Brevity
2) Name of operator
3) QTH or grid locator
4) graphics

20) Packet is allowed on Novice frequencies.
1) True
2) False

21) SKIPCON is:
1) an HF packet linking system
2) limited to speeds under 100 baud
3) an AMRAD project
4) all of the above

22) The TNC uses a bit-oriented standard known as:
1) an HDLC
2) an HLPT
3) a VADCG
4) an RS-232C

23) 1,200 baud is roughly equivalent to how many CW words-per-minute?
1) 60 wpm
2) 120 wpm
3) 500 wpm
4) 1,500 wpm

24) A TNC is roughly equivalent to what other type of computer peripheral?
1) modem
2) file server
3) terminal
4) printer

25) Packet is not allowed on 6 meters.
1) True
2) False

WHERE IS IT?

This is where the *73* staff would like to go after a hard day's work, or even an easy day's work, but we can't find it! We will give the first person to help us a year's subsription—or subscription extension—to *73*. *Mail* us, *in an envelope*, the full address and *identify the next-door sandwich shop!* Address: *73* Magazine Bar Contest, WGE Center, 70 Rte. 202N, Peterborough NH 03458. Earliest postmark will be the winner. Photo by Tedd Cluff.

THE ANSWERS

1—2 Data is contained in "packets" or bundles of data. A very frequency-efficient way to send information, since the transmitter is keyed on only when data is sent. And data is always sent at the fastest possible rate.
2—2 A packet may also contain such non-ASCII codes as Baudot or EBCDIC.
3—4 Helps to keep users from hogging a channel.
4—3 After years of lobbying by hams.
5—2 Band conditions and frequency constraints are the limiting factor.
6—4 Pretty fast.
7—3 Not a bad start.
8—4 But I bet you they eventually will.
9—2 Two meters, primarily.
10—1 Just a fancy name for a bunch of packet users.
11—3 Particularly on the east coast.
12—2 Almost any packet station can act as a digipeater.
13—2 It should come on every 10 or 15 minutes, at most.
14—1 AF2M is an Extra-class ham.
15—2 Ah. The old Silicon Valley crowd wins again.
16—4 The serial interface found on most personal computers.
17—2 A logical name.
18—2 TERRACON may one day link together all North American packet users through microwave relays.
19—4 Sort of a time and frequency waster.
20—1 But not by Novices, unfortunately.
21—4 HF may be unpredictable, but still useful.
22—1 High-Level Data Line Control.
23—4 Shows you how s-l-o-w CW is.
24—1 A very smart modem.
25—2 Although your neighbors may wish so.

SPECIAL EVENTS

COLUMBUS IN
APR 5

The Third Annual Columbus Amateur Radio Club Swapfest will be held Saturday, April 5, from 9 am to 5 pm at the Columbus IN 4-H Fairgrounds on SR 11 South. Talk-in on 146.790 repeater. For advance reservations write Chuck Roberts WD9DWI, 2950 S. Lake Drive, Columbus IN 47203.

ROCHESTER MN
APR 5

The Ninth Annual Rochester Area Hamfest will be on Saturday, April 5, starting at 8:30 am (setups on Friday from 4:30–6:30 pm). Sponsored by the Rochester Amateur Radio Club, Inc., raffle and drawings prizes include: Kenwood TR-2600 synthesized HT, Bearcat 20/20 programmable scanner, and a Ham IV rotor. Tables will be $8 each. In lieu of cash payment for tables you may donate prizes of at least equivalent value. In this case, prize certificates received will serve as advanced payment and reservation confirmation. For more information, write W.C. McGurk WB0YEE, 2253 Nordic Ct. N.W., Rochester MN 55901, or call (507)-288-7688.

MADISON WI
APR 6

The Madison Area Repeater Association will hold its 14th annual Madison Swapfest on Sunday, April 6, at the Dane County Exposition Center Forum Building in Madison WI. Doors will open at 7:30 am for flea-market sellers and at 8 am for the public. Admission is $2.50 in advance and $3 at the door. Flea-market tables are $5 in advance and $6 at the door. Talk-in will be on the M.A.R.A. repeater, WB9AER/R, 146.16/.76. For more information, write: M.A.R.A., PO Box 3403, Madison WI 53704, or call (608)-222-4744, day or night.

OLD BRIDGE NJ
APR 6

The Old Bridge Amateur Radio Association will hold an indoor/outdoor Electronics Flea Market, April 6, at the Knights of Columbus Hall in Old Bridge. The hall is located on Pine Street off Rt. 18 in Old Bridge. Talk-in frequencies are 147.120+600 and 146.520. Admission will be charged and a door prize will be awarded. Sellers may register by mail. Send SASE for details to Bob Navin, 106 Madison Ave., Old Bridge NJ 08857.

CLARKSVILLE TN
APR 6

The Clarksville Amateur Transmitting Society is sponsoring a swapfest on Sunday, April 6, starting at 9 am, at the National Guard Armory on Highway 41A in northern Clarksville. Amateur license tests will be given. Admission is free. Tables are $5.00 (single) and $7.50 (double). Talk in on 146.205/.805 or 147.43. For reservations or information, contact CATS, 1550 Armistead Drive, Clarksville TN 37042; (615)-648-3657.

TIMONIUM MD
APR 6

The Baltimore Amateur Radio Club will present the 1986 Greater Baltimore Hamboree and Computerfest on April 6 at the Maryland State Fairgrounds Exposition Complex at Timonium MD. Gates open at 8 am. The fairgrounds are located east of I-83 exit 17, three miles north of I-695, just north of Baltimore. Admission is $4, children under 12 free. For further information, contact: G B H & C, PO Box 95, Timonium MD 21093-0095, or call (301)-561-1282. For a recorded announcement, dial: (301)-HAM-TALK.

GROSSE POINTE MI
APR 6

The South Eastern Michigan Amateur Radio Association (SEMARA) will hold its 28th annual Hamfest Swap and Shop at the Grosse Pointe North High School, 707 Vernier Road, Grosse Pointe Woods MI, from 8:00 am to 3:00 pm. The Hamfest will feature an ARRL forum, DX forum, and a RTTY forum. Advance tickets $1.00, at the door, $3.00. Advance tables $8.00, at the door, $10.00. Talk-in on 147.75/.15 and 146.52. For more information, write to SEMARA Hamfest, PO Box 646, St. Clair Shores MI 48080, or phone Fred Lewis NK8M at (313)-881-0187.

KANSAS CITY MO
APR 11–13

The PHD Amateur Radio Association, Inc., will sponsor the annual Missouri State ARRL Convention April 11–13. Location is the old Kansas City MO airport, just north of downtown Kansas City MO. There will be commercial exhibits and 300 swap tables, all indoors. The banquet will be held Saturday night. Registration is $4 (good all 3 days), and swap tables are $10 (includes one registration). Banquet and swap tables should be requested in advance. Talk-in on 24/94 repeater. Registration and other information is available from the PHD Amateur Radio Association, PO Box 11, Liberty MO 64068-0011, or call (816)-781-7313 or (816)-452-9321.

SAGINAW MI
APR 11–12

The Saginaw Valley Amateur Radio Association, Inc., (SVARA) is hosting a State Convention for ham radio operators and computer buffs at the Saginaw Civic Center, April 11 and 12. NASA astronaut Tony England will be the featured speaker. For further information, write or call SVARA, PO Box 6662, Saginaw MI 48608, (517)-752-9740 or 776-1470.

BERWICK BICENTENNIAL
APR 12

The Columbia–Montour ARC will sponsor Special Event Station KC3TX commemorating the bicentennial of the city of Berwick PA. Operation will be in the General-phone portion of the 20- and 40-meter bands from 1700Z to 2400Z on April 12.Send QSL and $1 for a nice certificate to CMARC, PO Box 930, Berwick PA 18603.

GREENCASTLE IN
APR 12

The Putnam County Amateur Radio Club will hold its fourth annual Hamfest and Auction April 12, at the Putnam County Fairgrounds, north of Greencastle IN on US 231. Admission is $3 per person; children under 12 are free. Doors open for setup at 6:30 am, and open to the public at 8 am The auction is at 1 pm. Flea market space: our tables $3 each; your tables $2 each. Commercial exhibits welcome. Talk in 147.33/.93. For more information or table reservations send a SASE to Kent Douglas K9JCR, RR#4 Box 586, Greencastle IN 46135; (317)-672-8237, or Nick Aubrey N9FCB, RR#2 Box 592, Greencastle IN 46135; (317)-653-5290.

LAWTON OK
APR 12

Lawton Fort Sill Amateur Radio Club's annual event will be held April 12 at the County Fairgrounds, 8 am to 6 pm. This year the theme is "An Old-fashioned Swapfest." Registration fee is $2; table fee is $5; tailgate fee is $3. No pre-registration necessary except for table space. For more information, write Don Hagler, 912 Bell, Lawton OK 73505.

FRAMINGHAM MA
APR 13

The Framingham Amateur Radio Association will hold its annual Spring Flea Market and exams on Sunday, April 13, at the Framingham Civic League Building, 214 Concord St. (Rt. 126), downtown Framingham. Doors open at 10 am (sellers may begin setup at 8:30). Admission is $2, and tables are $10 (includes one free admission). Pre-registration is required for tables and exams. Talk-in on .75/.15 repeater. To reserve tables, write Jon Weiner K1VVC, 52 Overlook Drive, Framingham MA 01701, or call (617)-877-7166. To register for license exams, send completed form 610, copy of ham license, and a check for $4 (payable to ARRL/VEC) to FARA, PO Box 3005, Framingham MA 01701. Walk-in exams given on a space available basis.

BEDFORD PA
APR 13

The annual Southern Alleghenies Hamfest '86 will be held from 7 am to 4 pm on Sunday, April 13 at the Bedford County Fair Grounds in Bedford PA. (Pennsylvania Turnpike, Exit 11). Admission is $3. Plenty of tailgate space is available. Inside table spaces reserved at your request. A consignment auction will be held. Sponsored by the following clubs: Horseshoe Radio Club, Blue Knob Repeater Association, Bedford Co. ARC, Mountain ARC, and Somerset Co. ARC. Talk-in on 145.49/.89, 144.42/.92, and 146.52 simplex. For more infor-

mation, contact Gay Rembold W3DFW, 949 Winifred Road, Cumberland MD 21502, or call (301)-724-0674 or (814)-445-7486.

MOORELAND OK
APR 13

The Great Plains ARC fifth annual Northwest Oklahoma Eyeball & Swapmeet will be held in Mooreland OK on Sunday, April 13, starting at 9 am; $2 admission at the door. Covered-dish dinner at noon. Local airport. Dealer and swap tables available at no charge. Talk-in on 147.72/.12, 146.13/.73 and 146.52 simplex. VE test given on Saturday, April 12. Campsites available. Directions: North on Main or Elm streets, across the tracks and west. For further information, call (405)-994-5394 or contact Gordon Richmond NR5L, Rt. 1, Box 12, Mooreland OK 73852, (405)-994-5453; or Gerald Bowman N5CCV, Box 356, Mooreland OK 73852.

TASTE OF ATLANTA
APR 18–20

The Metro Atlanta (GA) Telephone Pioneers Amateur Radio Club (MATPARC) will operate special station W4OTA during the Taste of Atlanta food festival April 18–20. Operation on Friday and Saturday will be from 1500Z to 0300Z, and the station will be on Sunday from 1700Z to 2300Z. Frequencies are 7.285, 14.285, 7.055, 14.055, 144.81/.41, and 449.150/444.150 MHz. A special QSL is available for an SASE sent to MATPARC/Taste of Atlanta, John C. Parker, PO Box 54017, Atlanta GA 30308.

SOUTH SIOUX CITY IA
APR 18–19

The Midwest Convention of the ARRL will be held at the Marina Inn in South Sioux City IA on April 18 and 19, under the sponsorship of the 3900 Club. The convention will feature forums and an indoor flea market, and commercial exhibitors will be on hand to answer questions on the latest equipment. Bring your 2-meter rig for a free "tune-up," courtesy of Burghardt Amateur Center. Volunteer exams will be given on Friday the 18th. Pre-registration information should be directed to Dick Pitner WØFZO, 2931 Pierce, Sioux City IA 51104. Flea market reservations should be sent to Glenn Holder KØTFT, RR#1, Hinton IA 51024. Further information can be obtained through Convention Chairman Al Smith WØPEX, 3529 Douglas St., Sioux City IA 51104.

GROTON CT
APR 19–20

The Radio Amateur Society of Norwich (RASON) will operate Croaker Memorial Special Event Station KA1IFG from 1700Z April 19 to 1700Z April 20 from aboard the submarine *USS Croaker* to commemorate the 42nd anniversary of its commissioning. Look for us on these frequencies: SSB—3.890, 21.290; CW—3.730, 7.130, 21.130. QSL with SASE to RASON, PO Box 903, Norwich CT 06360.

HAM AND YAM FESTIVAL
APR 19–20

The Johnston Amateur Radio Society will help celebrate the second annual Smithfield (NC) Ham and Yam festival with special event station KA4HAM. Operation is from 1400Z to 2400Z both days on 3.855, 7.230, 14.255, 3.708, and 7.110 MHz. For a special QSL and certificate send a large SASE to Mark Gibson N4MQU, PO Box 2084, Smithfield NC 27577.

SULLIVAN IL
APR 20

The Moultrie Amateur Radio Klub (MARK) hamfest, formerly held at Sullivan IL, will be held Sunday, April 20, from 8 am to 3 pm at the Coles County Airport, located between Mattoon and Charles IL on Rt. 16. The hamfest will be in a large, heated hangar. Admission is $2 advance, $3 at door. No extra charge for vendors, but bring tables. Talk-in on 146.655/146.055 or 146.52. Further information, write MARK, PO Box 79, Sullivan IL 61951, or call Vernon Jack K9SWY at (217)-728-7596.

CAMBRIDGE MA
APR 20

The MIT Electronics Research Society and UHF Repeater Association will hold its tailgate high-tech, computer, and amateur radio Flea Market on Sunday, April 20, from 10 am to 4 pm, at Albany and Main Street in Cambridge MA. Admission is $1.50. Free off-street parking for 500 buyers. Tailgate room for 200 sellers. In the event of rain, covered tailgate area will be available for all. Sellers: $5 per space (includes one admission). Setup 9 am. For space reservations or further info, contact Jamie at (617)-262-5090 or 253-2060. Talk-in on 146.52 and 449.2/.444.2 (W1XM/R).

BRAINTREE MA
APR 20

The South Shore Amateur Radio Club of Braintree MA will hold its annual indoor flea market on Sunday, April 20, at the Viking Club, 410 Quincy Ave., Braintree MA from 11 am to 4 pm. There will be tables available for $12 each, which includes one free admission if paid for in advance by sending the appropriate amount to Ed Doherty W1MPT, 236 Wildwood Ave., Braintree MA 02184. Tables will cost $18 on the day of the sale. Checks should be made payable to the South Shore Amateur Radio Club. Confirmation of check receipt will be sent; no cancellation refunds after April 16. The Viking Club will open to vendors only at 9:30 am. Entrance fee $2. Plenty of parking. Questions? Call (617)-843-4431, evenings.

DAYTON OH
APR 25

The Miami Valley FM Association will sponsor the 17th annual B*A*S*H, on Friday night of the Hamvention, April 25, at 7 pm in the Conference Center at the Hara Arena and Conference Center, Dayton, Ohio. There is no admission charge.

DAYTON OH
APR 25–27

The Dayton Amateur Radio Association, Inc., will sponsor the Dayton Hamvention on April 25–27, 1986, at the Hara Arena and Exhibition Center, Dayton OH. Admission, valid for all three days, is $8.00 in advance, $10.00 at the door. Banquet tickets: $14.00 in advance, $16.00 at the door *if available.* Ladies luncheon, $6.75. Advance sale deadlines: April 5 (Canada) and April 12 (USA). Roy Neal K6DUE will be the banquet speaker.

Giant Flea Market: noon Friday through Sunday. *All spaces sold out.*

Technical forums on: personal computer, packet radio, ARRL, AMSAT, antennas, RTTY, SSTV/ATV, FCC, electrical safety, and other topics. CW Awards—try to break the 72.5-wpm world record!

License exams: Novice through Extra, by reservation only. Send before March 29: completed form 610, a copy of your present license, and check or money order for $4.25 payable to ARRL/VEC, to: License Exam, Attn. Tom Holmes, 8830 Windbluff Pt., Dayton OH 45459.

Send nominations for "Radio Amateur of the Year," "Special Achievement," and/or "Technical Achievement" Awards, to Awards Chairman, Box 44, Dayton OH 45401, before April 1.

For further information, see HAMVENTION ad on page 23.

DAYTON OH
APR 25

The Dayton-Cincinnati chapter of the Quarter Century Wireless Association will hold its 1986 annual banquet on April 25, the Friday night of the Dayton Hamvention. Leland Smith, national QCWA president, will speak on "The Future of Amateur Radio." Happy hour is at 6:30; dinner is at 7:30 at the Imperial House, I-75 and Needmore Road. For tickets and information contact Bob Dingle KA4LAU, 657 Dell Ridge Drive, Dayton OH 45429. QCWA membership is not required to attend.

FITCHBURG MA
APR 26

The Montachusett Amateur Radio Association will hold Flea Market Saturday on April 26 at the Knights of Columbus Hall on Electric Avenue, Fitchburg MA. Doors open at 8 am for sellers and 9:30 am to 3 pm for buyers. Talk-in on 144.85/145.45 and 146.52. Admission is $1; tables $8 each. For table reservations send check payable to M.A.R.A., c/o James Beauregard, 7 Mountain Ave., Fitchburg MA 01420.

CEDARBURG WI
MAY 3

The Ozaukee Radio Club, Inc., will sponsor its 8th annual Cedarburg Swapfest on Saturday, May 3, from 8 am to 1 pm at the Circle B Recreation Center, Highway 60 and County I, in Cedarburg WI (20 miles north of Milwaukee). Admission is $2 in advance, $3 at the door. Four-foot tables are $3 each. Sellers will be admitted at 7 am for setup. For more information, send a business size SASE to 1986 ORC SWAPFEST, 101 E. Clay St., Saukville WI 53080.

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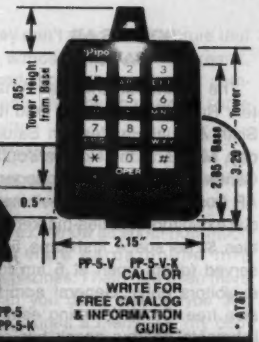

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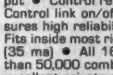

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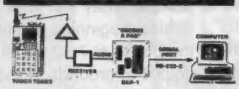

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ROGERS AR
MAY 3

The Northwest Arkansas Amateur Radio Club, Inc. will hold its Sixth Annual Hamfest on Saturday, May 3, at the Rogers Youth Center, 315 W. Olive St., Rogers AR from 8 am to 4 pm. Commercial exhibitors and flea-market tables, $2 per space, first come, first served (doors open at 6 am for exhibitors only). General admission free. Parking, eating establishments nearby; snack bar on premises. Talk-in on .16/.76, .63/.03 and .52 simplex. For more information, write Roy Milliren AF5W, 2014 S. 16th St., Rogers AR 72756.

STIRLING NJ
MAY 4

The TCRA Hamfest (Tri County Radio Association) will be held rain or shine on Sunday, May 4, from 9 am to 3 pm at the Passaic Valley Community Center off Valley Road, Stirling NJ. Free parking is available. Tables are $7, ac $10. Registration is $2. Limited tail-gating by reservation only please. All reservations through Dick Franklin W2EUF, Box 182, Westfield NJ 07090; (201)-232-5955.

MELVILLE LI NY
MAY 4

The Suffolk County Radio Club Indoor-Outdoor Electronic Flea Market will be held Sunday, May 4, from 8 am to 3 pm at Republic Lodge No. 1987, 585 Broadhollow Road (Route 110), Melville LI, NY. Plenty of free parking. General admission is $2 (wives and children under 12 admitted free). Indoor sellers tables are $7 and outdoor space is $5; each includes one admission. Talk-in on 144.61/145.21 and 146.52. For additional information, contact Bill Sullivan N2ETG, (516)-689-9871, evenings.

GRAND JUNCTION CO
MAY 10

The Grand Mesa Repeater Society will hold the Seventh Annual Western Slope Amateur Radio and Computer Swapfest on Saturday, May 10, 1986, from 9:00 am to 4:00 pm at the National Guard Armory, 482-28 Road, Grand Junction CO. Admission is free and swap tables are $5.00 each. Features will include an indoor swapfest, amateur radio exams, a packet radio demonstration, an auction, and refreshments. Talk-in on 146.82 and 449.20. To reserve a swap table and for further information, send an SASE to Larry S. Brooks WBØECV, 3185 Bunting Ave., Grand Junction CO 81504, or call (303)-434-5603.

ROCHESTER NY
MAY 16–18

The Rochester Hamfest and Atlantic Division ARRL Convention, sponsored by the Rochester Amateur Radio Association, Inc., will be held May 16, 17, and 18 at the Monroe Country Fairgrounds, Rochester NY. Tickets are $5 in advance, $7 at the gate. There will be an outdoor flea market, $5 per space. Special indoor flea market for non-commercial exhibitors, upon application in advance only, $75. For tickets, write Hamfest Tickets, 174 Croydon Road, Rochester NY 14610. For more information, write Rochester Hamfest, 300 White Spruce Blvd., Rochester NY 14623, or phone the Hamfest BBS at (716)-424-7136. Talk-in on 146.28/.88. Please note: If you plan on staying at a motel within 40 miles of Rochester, reservations are a must!

RANDOLPH OH
MAY 18

The Portage Amateur Radio Club, Inc., will hold the 1986 Portage Hamfair for radio amateurs and computer hobbyists on Sunday, May 18. It is open for dealers beginning at 6 am and for the public at 7:30 am at the Randolph Fairgrounds, Randolph OH. This fairgrounds facility will accommodate indoor dealer sales as well as an outdoor flea market. Indoor/outdoor spaces can be purchased for either $2 for each 10-foot linear space (no table or chair) or $6 with 8-foot table and chair. Advance reservation recommended; otherwise tables will be available at the door on a first-come-first-served basis. Admission is $3 in advance, $3.50 at the gate. Talk-in on 144.79/145.39. For info or tickets, write Robert Ducotey KX8V, 9971 Diagonal Road, Mantau OH 44255 or call Garry Delagach KD8JM at (216)-274-8240.

KNOXVILLE IL
MAY 18

The Knox County Amateur Radio Club, Inc., 4th Annual Hamfest will be held on May 18, at the Knox County fairgrounds (exit 51 off Interstate 74). Camping area available. Flea market. Large commercial vendor building. Gate opens at 7 am, Commercial Building at 9 am. Donations $4 at gate or $3 in advance to Stuart Schrodt, RR2, LS 19, Avon IL 61415; (309)-465-3107.

DURHAM NC
MAY 24

The Durham FM Association will hold its annual Hamfest and Computerfest on Saturday, May 24, at the lower level of South Square Mall in Durham NC from 8 am to 4 pm. The flea market will be held under a covered parking deck. Talk-in will be on 147.825/.225. Free parking, numerous prizes, and tables will be available. FCC exams are planned. Admission will be $4 at gate. For further information, contact D.F.M.A., PO Box 8651, Durham NC 27707, or call Mick W4ZUS at (919)-544-3556.

TRACY QUE
MAY 25

The Quebec Provincial Hamfest will be held Sunday, May 25, beginning at 9 am (8 am for exhibitors) at the Tracy Curling Club, Place du Centre Civic, Tracy, Quebec Province, Canada. Indoor tables are $8 (includes one admission); outdoor tables are $6—reserve all tables before May 20. Admission is $4. Talk-in, VE2RBS 146.610/.010. Write C.R.A. Sorel-Tracy, C.P. 533, Sorel, Quebec, Canada J3P 5N6.

BEAVERTON OR
JUN 6–8

The 6th annual SEA-PAC Convention (formerly Oregon State) will be held from 5 pm Friday, June 6, to about 2 pm, Sunday, June 8 (open for setups at 10 am Friday), at the Seaside Convention Center, Seaside, OR. Booth space is 8 ft. x 10 ft. with table, chairs, power, and so on for $120; 24-hour security is provided. For motel information, call (800)-452-6740 (from Oregon only) or (503)-738-6391; for other information, write OTVARC, PO Box 5132, Beaverton OR 97006 or call, evenings only, (503)-640-5456 or (503)-297-1175.

WILLOW SPRINGS IL
JUN 8

The Six Meter Club of Chicago, Inc., announces its 29th annual Hamfest, to be held Sunday, June 8, 1986, at Santa Fe Park, 91st and Wolf Road, Willow Springs IL (southwest of downtown Chicago). Reservations for space in the pavillion will be accepted on a first come, first served basis. A donation of $20 in cash per table space is requested. For details, write John Trepina K9QYT, 5015 W. 31st Place, Cicero IL 60650.

RAILROAD DAYS
JUN 21–22

The Great Plains ARC will hold a special-event station June 21 and 22 in conjunction with Railroad Days in Oelwein IA. The bands used will be 20m at 14.235 ± QRM, 40m at 7.235 ± QRM, and 80m at 3.970 ± QRM. The call used will be KCØCP. For certificate, send SASE and QSL to KCØCP, Box 203, Oelwein IA 50662.

GERMANTOWN MD
JUL 27

In celebration of the 40th anniversary of Montgomery College, Montgomery County MD, the Germantown Campus Amateur Radio Club will operate KV3S on Sunday, July 27, 1986, from 1300Z to 2000Z. Frequencies: 7.240 and 14.240 (approximate). A certificate will be awarded to all. Special certificates will be awarded to those whose birth year is 1946 and to those who work KV3S on the 40-meter band. For certificate, send QSL and large SASE to KV3S, Montgomery College, Germantown MD 20874.

ESCANABA MI
AUG 2

The 38th annual Upper Peninsula Hamfest, sponsored by the Delta County Amateur Radio Society (DCARS), will be held August 2, at Bay de Noc Community College in Escanaba MI. This is an ARRL-sanctioned Hamfest and the only one to take place in the upper peninsula of Michigan. Registration will be $2. Donations from organizations to be used for door prizes and awards would be greatly appreciated. All donations will be displayed with the donor's name prominently shown. Donations should be sent to Hamfest Co-chairman Tom Elegeert K8MJK, 1403 S. 13th St., Escanaba MI 49829. For further information, contact Co-chairman Aileen Gagnon WA8DHB, 9159 Bay Shore Drive, Gladstone MI 49837.

NEVER SAY DIE

from page 11

Some just make a noise—others call the police by telephone, others use radio.

Now if you really want to get into it in a very big way, how about putting together some alarm kits and selling them by mail order? I saw plenty of car alarms at the Consumer Electronic Show in Las Vegas in January, but little in home alarm kits. If I wasn't busy with a lot of other things I'd do it myself. Just what I need—one more business. I'd tell you about all the businesses I'm in now, but you wouldn't believe me.

One of my areas of expertise is in making lots of money. I not only have done it, I also give talks on the subject. There are a million millionaires in the United States, so it's no big deal anymore. Almost anyone who really wants to can make a million. I counted ten hams who stopped me at CES to thank me for goading them in my *73* editorials into starting their own businesses and getting rich.

I don't know if you've noticed 8mm video yet. Well, I bought a Sony 8mm camera and VCR and I want to tell you that from what I can see 8mm is going to quickly wipe out Beta and then, eventually VHS. We're going to be seeing low-cost, high-quality video cameras all over the place. Mark my words, you're going to see 8mm video used by virtually every business and in most homes. If you want to get in on the next consumer electronic explosion, see what you can do making some 8mm video accessories or opening 8mm video stores. 8mm video is darned close to ¾-inch video in quality—and a lot better than the ½-inch Beta and VHS formats. The cameras are small and light. The 8mm tape cassettes are about the size of an audio cassette.

For a while the computer business was an easy way to make money. That's slowed down now, but there are other industries coming along. Let me know if you want me to write more about the opportunities. I'll have to swear you to secrecy—we don't want any non-hams getting in on a good thing, do we?

READER'S SERVICE CARDS

I don't know why the previous publisher of *73* dropped the reader service cards—but they're back. The cards are there for you to use to get more information on products you're interested in buying. Buying ham gear is a lot of fun. I don't know of much more exciting than opening up a ham rig carton and setting up a new rig.

Please remember that it's the advertisers who make *73* possible—so treat them kindly. They get all excited when they think you're interested in their products, so give them a shot of adrenaline by circling their number on the card. From there on it's up to how good they are at sending you a sales pitch on their product. If they do a good solid job of selling, who can resist? If they don't send you literature that is almost impossible to resist, send it on to me with your comments. Maybe they need some help.

Whatever you do, don't be casual about the reader's service card. Tear it out and use it.

Yes, I know all about how much you hate cards bound into magazines. I hate 'em even more than you do. I read maybe 300 magazines a month, so my bedroom floor is ankle deep in blow-in and bind-in cards I rip out so I can turn the pages. Let me know if you are interested in starting a collection. So why all the cards in magazines? Because the foolish things work, that's why. Why did you think?

I fought the idea for a long time. Then I reluctantly tested it and found how well they worked compared to a coupon printed on a page. No comparison. So I grit my teeth and do what works, whether I personally like it or not. Permission is granted for you to hate the cards—rip 'em out—but then fill 'em in and mail 'em to me—with reader's service and subscriptions.

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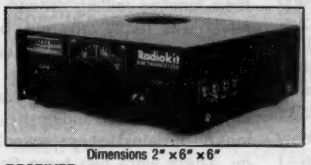
COMPACT 75 M SSB TRANSCEIVER



Dimensions 2" × 6" × 6"

Complete Kit
$199.95
plus $3.00 shipping and handling

1985-86 CATALOG 50¢

RECEIVER:

Frequency	3.8-4.0 MHz
Sensitivity	0.5 μV for 10 dB S/N
Selectivity	−6 dB @ 2.4 KHz
AGC Range	+60 dB in = +3 dB out
Audio Ouput	>350 mW into 8 ohms

TRANSMITTER:

Frequency	3.8-4.0 MHz
Output	30 watts into 50 ohms
IMD	−30 dB
Harmonics	2nd −47 dB, 3rd −55 dB
SWR Immunity	30:1 @ all phase angles

ALC Amplified, fast response rate (quasi-processing)

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POWER REQUIREMENTS:

Voltage	28 Vdc regulated
Current	2A transmit, 65 mA receive

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r-33 telex 667697

THEY LAUGHED WHEN I SAT DOWN TO BUILD . . .

How would you like to get involved with building some interesting ham projects? Even if you've never pointed to a soldering iron in anger—good grief, there I go dating myself again. Soldering iron, forsooth! Okay, okay, soldering pencil.

While it isn't prudent to tackle building your own synthesized sideband transceiver these days, it's about the only way you're going to get many small gadgets that will be fun to have around your shack. And I have a sneaky plan to bribe you to design and build simple projects.

If you tune around 75m some evenings and listen to the old-timer round-table discussion grousing about how hams don't build anymore, you may tend to believe these fogies. Balderdash! As I've mentioned before, in the early days of ham radio every ham had to build his own receiver and transmitter. Then, when Hallicrafters came out with their first ham receiver (was it the S-1 Skyrider?) hams immediately stopped building receivers.

We all built our own transmitters until well after WWII. It wasn't until then that we had enough hams to make the commercial building of ham transmitters profitable. Amateur radio really got going after 1945, growing a steady 11 percent a year for 17 years—a nice market for commercially made ham rigs.

The few hams who built their own transmitters discovered that this was stupid. The cost of the parts ate them up—and then, when they wanted a new rig they found no sale at any price for a used home-made rig.

One of the reasons I started *73* magazine in 1960 was to publish as many simple construction projects as I could to encourage hams to keep building. I published mountains of articles on building ham gadgets, test equipment, antennas, audio stuff, electronic toys and so on. It worked.

73 was the pioneer in getting hams to build VHF and UHF gear—in getting hams to build solid-state equipment—and then digital, even getting the readers into computers.

No matter how much commercial ham gear we have available, there is still an almost unlimited number of interesting things that we can have only if we build them. Now, 25 years later, *73* is again going to get ham building going in a big way. As I said, I have a sneaky plan.

KIT SUPPLIER WANTED

First, I'm looking for a "Chosen Instrument" company, one that will work with me to make parts kits available for the articles published in *73*.

I'm sure it has not entirely escaped your notice that parts are darned hard to find these days. It's enough to discourage most of us after one or two attempts. It's not like it is in Japan where there is a whole section of Tokyo that specializes in selling electronics parts. There are hundreds of small parts stores—all swarming with thousands of happy Japanese youngsters buying parts. The best we seem to have these days is the slim selection of overpriced parts from Radio Shack stores.

It isn't that there are no parts being made; it's just that you have to buy them in bulk these days—as a manufacturer. The 1963 Incentive Licensing disaster not only put 90 percent of the ham stores in America out of business, it also killed the distribution of electronic parts.

In 1964 I tried to solve this problem by setting up a Parts Kit division of *73*. I bought a huge metal knife to cut out the chassis and panels, a metal brake to bend them, a metal punch set to make the needed large holes and a drill press for the small holes. I bought parts by the zillions from Evans Radio in Concord NH, and sold thousands of boxes of parts for the *73* construction projects.

The parts kits business went well. Oh, a few ham dealers got mad at me for "taking business away from them." But it did encourage thousands of readers to build. The bad aspect was that it kept me incredibly busy. In addition to the kits, I was running a small printing press putting out a monthly VHF magazine, a club newsletter, and an ATV magazine. Then, when my divorce hit, I lost my steam and had to cut back—which included stopping the kits and the small magazines. I even had to get someone else to run *73* for a couple of years.

There's a nice living to be made in the kit business—not a big one, unless we get a spurt of new hams. If some firm is interested, *73* will work with it to coordinate kits and articles.

A ROYALTY TO YOU

Having parts kits is a waste of time unless we have articles on projects you want to build. What I have in mind here is some good old-fashioned bribery. Greed usually works just fine as a motivator. So here it is . . . if you make a gadget that you think *73* readers may be interested in duplicating, write it up, take some pictures, and submit an article. If we accept it, we'll pay you for the article upon acceptance—something some other ham magazines I could name don't do. Secondly, we'll work with the kit people to have a kit made up to support your project. You may want to work with the kit people to simplify or standardize parts. For instance, it isn't very helpful to specify some part you can pick up only at the Dayton flea market. Then, we'll see that the kit company charges enough for the kit so there's a 10 percent royalty in it for you.

Let's say you make up an RTTY demodulator that sells in kit form for $150. You get a $15 royalty on each sale. So, if only a thousand readers buy the kit, you'll get $15,000 bonus for your efforts. Heck, that could be a trip to Europe for you and the XYL, plus maybe a fur coat. You can do a great Asian tour for $6000 for the two of you. But then, you probably won't need expert advice on how to spend the rising tide of money your building efforts can provide. If you find yourself desperate for spending advice, I'll put you in touch with my XYL, a world-class expert.

I'll bet you have something in mind to build right now.

***HR* NOMINATED FOR PRIZE**

HR magazine set a new record in my mind when they reported in their February issue that I was back running *73* magazine. They quoted correctly that I view amateur radio as a dying hobby—and quoted *in*correctly that I've ever said I no longer had any serious interest in it. You won't find anyone anywhere who's ever heard me say that—even on a bad day.

So, with *HR* reaching a new high—only 50 percent wrong—I think they should be given positive encouragement to shake their old "Half Right" nickname. Alas, it seems to have been an impossible goal for them so far, but who knows?

MIAMI HAMBOREE '86

With our hobby coming apart at the seams, how are institutions such as the Hamvention and the Miami Hamboree doing? Even though I wasn't invited to come, I decided to check the Hamboree out.

The Hamboree committee really went out of their way to make things convenient for exhibitors—coffee and doughnuts in the morning and nice lunches delivered to the booths. Dayton, take note!

It's a bit of a shock to get on the plane in Boston with the February temperature well below freezing and emerge in Miami with temperatures in the 80s. I flew down on beleagured Eastern Airlines, using my "Get Up and Go" senior citizen's pass.

The pilot enthusiastically explained all about the brand new Boeing plane he was so proud to be flying—one of the reasons, as I recall, why Eastern is in so much financial trouble. The new plane looked like a worn out junker to me. My tray table was already broken on one side. The toilet light didn't work. The lock on a storage cabinet in the toilet wouldn't close, so the door disconcertingly kept swinging open. This is a new plane? What'll it be like in a few months? It was workmanship like this that drove so many car buyers to foreign cars. Shape up, Boeing.

The Hamboree was in a new location this year—the Tamiami Fairgrounds. I think they've found a good spot. Well, a pretty good spot. There was no air conditioning, so even with a bunch of huge fans blowing, it got pretty hot, badly overloading current underarm deodorant technology.

As an exhibitor I was pleased with the number of attendees. With the help of *73* staffers Nancy Ciampa and Hope Currier, the *73* booth easily kept up with the traffic. I haven't seen the official counts, but I'd estimate they had at least two thousand hams and their families milling around. It never was really crowded, but there were few times when no one was in sight either.

As a show-goer I enjoyed having a chance to see and push buttons on the latest in ham technology. There were two huge flea-market halls, so even if it had rained, I still could have browsed dryly. It poured the day before the hamfest, so the potential was there, making the indoor sales area important.

I was a bit disappointed to see a few non-ham exhibits: Mary Kay cosmetics had a booth. And East-

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Band	Kit	Wired
10M,6M, 2M,220	$660	$880
440	$780	$980

FEATURES:

- SENSITIVITY SECOND TO NONE; 0.15 uV (VHF), 0.2 uV (UHF) TYP.
- SELECTIVITY THAT CAN'T BE BEAT! BOTH 8 POLE XTAL FILTER & CERAMIC FILTER FOR > 100 dB AT ± 12KHZ. HELICAL RESONATOR FRONT ENDS TO FIGHT DESENSE & INTERMOD.
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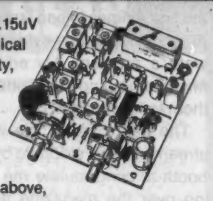

- **R144/R220 FM RCVRS** for 2M or 220 MHz. 0.15uV sens.;8 pole xtal filter & ceramic filter in i-f, helical resonator front end for exceptional selectivity, >100 dB at ± 12 kHz, best available today. Flutter-proof squelch. AFC tracks drifting xmtrs. Xtal oven avail. Kit only $138.
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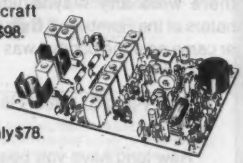

- **T51 VHF FM EXCITER** for 10M, 6M, 2M, or 220 MHz. 2 Watts continuous, up to 3 W intermittent. $68/kit.
- **T451 UHF FM EXCITER** 2 to 3 Watts. Kit only $78. Xtal oven avail.
- **VHF & UHF LINEAR AMPLIFIERS.** For either FM or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Several models. Kits from $78.

NOW—FCC TYPE-ACCEPTED TRANSMITTERS & RECEIVERS AVAILABLE FOR HIGH-BAND & UHF. CALL FOR DETAILS.

RECEIVING CONVERTERS

Models to cover every practical rf & if range to listen to SSB, FM, ATV, etc. NF = 2 dB or less.

Antenna Input Range	Receiver Output
28-32	144-148
50-52	28-30
50-54	144-148
144-146	28-30
145-147	28-30
144-144.4	27-27.4
146-148	28-30
144-148	50-54
220-222	28-30
220-224	144-148
222-226	144-148
220-224	50-54
222-224	28-30

VHF MODELS	
Kit with Case	$49
Less Case	$39
Wired	$89

UHF MODELS	
Kit with Case	$59
Less Case	$49
Wired	$75

432-434
435-437
432-436
432-436
439.25

28-30
28-30
144-148
50-54
61.25

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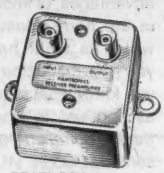
For SSB, CW, ATV, FM, etc. Why pay big bucks for a multi mode rig for each band? Can be linked with receive converters for transceive. 2 Watts output vhf, 1 Watt uhf.

	Exciter Input Range	Antenna Output
For VHF, Model XV2 Kit $79 Wired $149 (Specify band)	28-30	144-146
	28-29	145-146
	28-30	50-52
	27-27.4	144-144.4
	28-30	220-222*
	50-54	220-224
	144-146	50-52
	50-54	144-148
	144-146	28-30
For UHF, Model XV4 Kit $99 Wired $169	28-30	432-434
	28-30	435-437
	50-54	432-436
	61.25	439.25
	144-148	432-436*

*Add $20 for 2M input

VHF & UHF LINEAR AMPLIFIERS. Use with above. Power levels from 10 to 45 Watts. Several models, kits from $78.

LOW-NOISE PREAMPS



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FEATURES:
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- High Gain: 13 to 20dB, Depending on Freq.
- Wide Dynamic Range for Overload Resistance
- Latest Dual-gate GaAsFET, Very Stable

MODEL	TUNES RANGE	PRICE
LNG-28	26-30 MHz	$49
LNG-50	46-56 MHz	$49
LNG-144	137-150 MHz	$49
LNG-160	150-172 MHz	$49
LNG-220	210-230 MHz	$49
LNG-432	400-470 MHz	$49
LNG-800	800-960 MHz	$49

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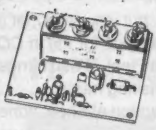

Model	Tuning Range	Price
HRA-144	143-150 MHz	$49
HRA-220	213-233 MHz	$49
HRA-432	420-450 MHz	$59
HRA-( )	150-174 MHz	$54
HRA-( )	450-470 MHz	$64

MINIATURE PREAMPS

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GaAsFET Preamps with features similar to LNG, except designed for LOW COST and SMALL SIZE: only 5/8"W x 1-5/8L x 3/4H. Easily mounts inside many radios.

MODEL	TUNES RANGE	KIT	WIRED
LNW-144	120-150 MHz	$19	$34
LNW-160	150-200 MHz	$19	$34
LNW-220	200-270 MHz	$19	$34
LNW-432	400-500 MHz	$19	$34

IN-LINE PREAMPS

NEW

GaAsFET Preamp with features like LNG. Automatically switches out of line during transmit. Use with base or mobile transceivers up to 25W. Tower mtg hdwr incl.

MODEL	TUNES RANGE	KIT	WIRED
LNS-144	120-150 MHz	$68	$98
LNS-160	150-180 MHz	$68	$98
LNS-220	200-240 MHz	$68	$98
LNS-432	400-500 MHz	$68	$98

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ern Airlines. Boo. Eastern, I still remember that you were one of the first airlines to ban laptop computers, without any evidence they were a problem. My editorial in *Microcomputing* magazine forced them to rescind that ban.

The best part for me was the stream of hams stopping by the *73* booth to congratulate me on taking over the magazine again. If there were any Wayne Green haters at the Hamboree, they never came near the booth. I was surprised at the number of no-code enthusiasts who admitted they'd been opposed to the no-code license idea until they better understood what really was at stake. They said they now regretted having written the FCC with their first emotional reaction.

I suspect it's too late now as far as no-code is concerned, but I'll spend some time one of these months explaining the whole situation in depth so you can, in turn, explain it to your more volatile, but possibly not very thoughtful, friends. I tend to forget now and then after 35 years of being a ham editor and publisher that I have a different perspective on ham history than hams who are either new or who haven't paid a lot of attention down through the years.

You see, I not only know all the players today, I've known them, both good and bad, ever since I started editing ham magazines—and this August will be my 35th anniversary of that. Yep, in 1951 I'd just gotten a job as a TV director at WXEL in Cleveland, Ohio. I'd been deeply involved with ham Teletype for a couple of years and was frustrated that no one was publishing a RTTY newsletter. Lo, there was a mimeo machine! A few days later the first issue of a RTTY newsletter was born—and my publishing career inadvertently started.

One of the advantages, or disadvantages, of knowing everyone in the ham industry personally, which is what happens when you're a magazine editor, is that you know what is really going on as opposed to what most hams *think* is going on—the facade presented in *QST*.

NEW DEVELOPMENTS

There are a lot of new developments in amateur radio that I've got to get you interested in—like packet radio, repeater cross-banding, and so on. Many of you may be trapped in the past, spending your declining years talking with the same crowd every night. I'm going to try and get you to try something new and exciting.

The one topic that came up the most at Miami was the need for youngsters in the hobby. I've been griping about that for how many years now? As usual, sigh, I guess I was ahead of my time. The ham manufacturers had a meeting and that was number one, two, and three on their agenda.

Sure, I can just hear the senile old farts bitching now—the manufacturers want more hams so they can make more money. You bet they do! But that isn't all. Few hams are in the ham business today just to make money—there are far too many ways to make money easier—a whole lot easier. Most of them are in the business because they love hamming. I wish I could say *all*, but I did see a couple well-known slime-ball crooks exhibiting at the Hamboree, crooks who've cheated hams for years and are still at it. I hear Dayton isn't going to let these bastards exhibit this year. I sure hope not. I've been terribly dismayed to see their ads in one of the ham magazines. I guarantee you won't see 'em in *73*.

Speaking of rip-offs, I just got word that an old-time rip-off artist died. Nice old chap made a living selling high-powered CB amplifiers and expensive mini-antennas that didn't work worth a hoot. I refused to carry his ads, but one of the other ham magazines helped hundreds—maybe thousands—of hams get fleeced.

Some of the biggest crooks in the hobby used to run their ads in *QST*—did for years—despite zillions of complaints. I can remember two who were convicted, one with with my help. I doubt if that can happen today. I don't think Dave Sumner would let it.

Getting back to kids. I've got some ideas on ways for us to get our hobby growing again. My goal is simple: one percent of our population should be hams. Yep, I'm looking for us to get to two and a half million hams. Heh, and you thought 20 meters was crowded right now! Well, don't jump to conclusions. The fact is, I believe we won't find our bands much more crowded than they are today. We'll have enough clout to have more bands and we'll have the enthusiastic youngsters we need to pioneer new modes and new bands.

You know, not one cry of alarm I've been hearing for years about the invasions of CBers has ever been anything more than emotional baloney from our lunatic fringe Chicken Littles. Every time we have a really serious bad apple in our hobby, it's turned out to be an old-time ham with an IQ in the home-temperature-comfort range.

Speaking of CB, it's perhaps with some perversity that I rub old timer noses in the fact that the worst CB bad language and jamming cases in history had Extra Class hams licenses.

CB didn't do much good for us, really. Oh, we got a few hams out of it, but most CBers never got much interested in hamming—and if they did, they found it much easier to move higher in the 27 MHz band than to try and learn the code. The sun-spot cycle, not the FCC, gradually killed this bunch off.

Continued on page 98

WIN $500!

How long have you been a ham? Okay, in all that time, how many really funny ham stories have you read? I've been publishing ham magazines for 35 years and there are precious few I can remember in all that time.

Larson E. Rapp use to get some chuckles a generation ago in *QST*. Say, who wrote those pieces? I think I heard one time, but I've forgotten. Scratchi did pretty well in *CQ* when I was editing it, also a generation ago. I've forgotten who did Scratchi now, too, but I'll bet some reader knows—same W2 who edited the *GE Ham News* around 1947—look through your collection and let me know.

I didn't realize what a closely guarded secret Scratchi's name was until I'd invited the *GE Ham News* editor over to talk to the club. During dinner before the meeting he mentioned that he'd just made a deal with *CQ* to start writing the Scratchi column again. It's one which had previously appeared in *Radio* magazine, which faded away when WWII started. *Radio* was a wonderful magazine—beat the heck out of *QST* in every way. The ARRL never really got over the death of it's founder, Hiram Percy Maxim—also known as The Old Man (TOM). When he suddenly died around 1936 there was a fight for power which I hope will someday be documented. Maxim wrote several wonderfully humorous books—his "A Genius in the Family" was a best seller in the 30s.

Getting back to ham humor, long, long ago in *73* I had a wonderful piece by Jean Shepherd K2ORS. Jeans' promised to do more, but hasn't gotten around to it yet. I hope you've seen his movies on PBS—vintage Shepherd and very nicely done. Sherry's taped Jean's Christmas movie from one of the cable channels. I hope Jean'll do some more work for us to add to ham humor posterity before he becomes a silent key.

The best humor I've seen in any ham magazine was by Bob Manning K1LSD. I'll start reprinting some of his *73* stories from twenty years ago so you can see what I mean.

Another ham with a great sense of humor, but who rarely let it go in print, was Sam Harris W1FZJ. He did a piece for me in *CQ* which is still a classic on his Contest 100 Watt Final. When things get dull I pull that off the shelf and read it to visiting hams.

What I'm leading up to is this. With the exception of Shep, none of these hams were professional writers or humorists. I'm sure there are dozens of you who, if you gave it a try, could entertain us. Here's where the $500 prize comes in. I'm offering $500 for the best ham humor story submitted during 1986—as voted by the *73* readers.

Let's see what you can do. You couldn't ask for better source material than ham radio for humor. Please double space your manuscript. You get extra points if you do it on a word processor—there are even some people still writing longhand, despite the popularity and speed of the typewriter. A word processor makes writing even faster and much easier.

Please send your piece to Ham Humor, *73* Magazine, WGE Center, Peterborough NH 03458 USA. The sooner the better.—W2NSD/1.

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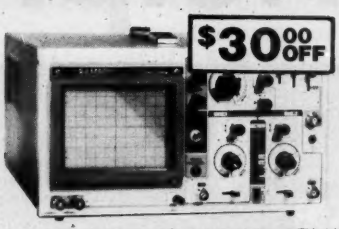

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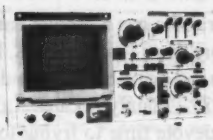

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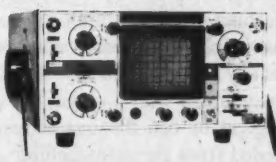

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CT-50 8 DIGIT 600 MHz COUNTER

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I'm Wayne W2NSD/1—amateur radio has a problem and I sure need your help. We need more hams—young hams. I've got some good ideas on how to get 'em, but I can't do it alone. I'm back at the helm at *73*—mainly because I care enough about amateur radio to devote time to trying to do something about it.

The first thing I'm going to do is make *73* a lot more interesting. Sure you like construction projects, but the closest thing to all our hearts is reading about new products. So, in addition to the usual *73* tests of new ham gear, I'd like to get your personal appraisal of any new gear you buy. We all want to know what problems you had with it—what fun it was—how it worked—how good or bad the instructions were—what support you needed from the manufacturer—and what support you got. The next time you buy some ham gear keep notes and write a letter to *73* with your personal report.

I'm also looking for articles on building projects—simple, weekend projects. And, with your help, I'll be running articles on how and why you should get involved with things like packet radio, cross-band repeaters, Oscar, RTTY and so on. Thousands of us are having a ball doing more than just spending our declining years rag chewing.

No, I don't ever expect you to agree with me on everything I write—but I guarantee to get you thinking and enjoying amateur radio more than you have. We have one of the best hobbies in the world—unfortunately it's also one of the better kept secrets—certainly as far as today's kids are concerned.

I have some ideas—some good ideas—on how we can get amateur radio growing again—the way it used to. But I need your ideas—and your help to make mine work. I'll work hard for you if you'll back me up, but I can't do it all.

One approach that can work is the one I suggested to the Chinese government leaders when I was there a few weeks ago. I think I can generate around five million hams in China—maybe ten. The Chinese seemed enthusiastic about my plan—maybe you will be too. You'll be reading about this in *73*.

I'm going to make *73* fun to read. I'm looking for feedback from you on many things. I want to run a monthly listing of every piece of ham gear, along with your vote on how good it is. You'll have a chance to support manufacturers who produce something you think is great. Or get in your two cents when you're disappointed.

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from page 94

A PUBLISHER'S WORK IS NEVER DONE

One thing—please do everything you can not to get upset if I don't answer you personally. I doubt if you know anyone who is as busy as me, so let's keep it with me writing editorials, you writing letters—and yes, I *do* read 'em. If you either are clever enough to make me laugh, or are so wound up about something as to actually be serious, there's a chance your letter, or at least embarrassing parts of it, may get published.

I'm not exaggerating about being busy. In addition to getting to hamfests, I also get to computer and consumer electronic shows—including a round of 'em in Asia in October. I also get out for some skiing in the winter and scuba diving in the summer, Honduras last August.

I'm also doing my best, which isn't all that good at times, to run a few businesses—like trying to get *73* magazine growing again in circulation and advertising. I sure need your help with this. Then there's my *Digital Audio* magazine, the *Green CD Catalog*, *Pico* and *Tele* magazines, five Instant Software computer stores and a mail order house around greater Boston, WGE Distributing, WGE International (importing), Green Publishing Institute, and a few smaller projects.

To these you add a number of new projects being started—magazines, new products and services—and perhaps you can appreciate why I don't have much time to answer letters.

There are a few civic duties too, such as being a director of IDG, the largest computer publishing firm in the world, an overseer for RPI, a member of the N.H. High Tech Council and the FCC's Long Range Planning Committee, things like that. I don't have many boring days.

If you're interested, I'll tell you more about some of my upcoming projects. Who knows, you might want to invest in one or two. I seem to be able to make a lot of money, and I haven't much use for it for myself.

I was very pleased by the many hams who stopped by the booth to say they're getting *Digital Audio* magazine and enjoying it. You might mention it to your compact disc fanatic friends.

I want to thank everyone who said hello at Miami and wished me luck with getting *73* to be more interesting. It'll take a while, but just watch.

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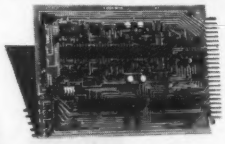

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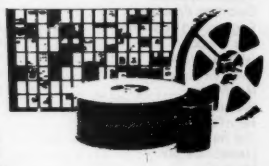

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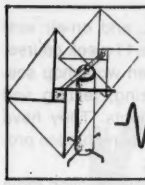

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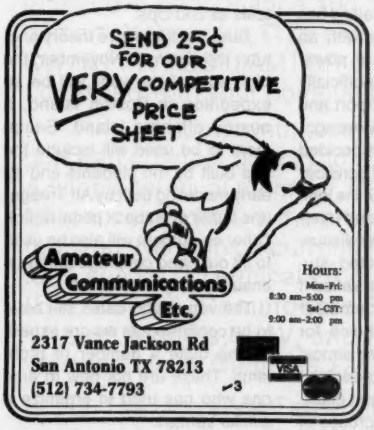

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73 INTERNATIONAL

Just because I started this column as a result of visiting DX hams is no reason you shouldn't put in your 2¢ worth and let me know what DX news you find most interesting. My inclination is to have DX ops tell us what they think is interesting—how we can get permission to operate if we're fortunate enough to visit—any coming DXpeditions—what's doing with repeaters—things like that. What do YOU find most interesting? Since we have a world hobby, I think you'll be as interested as I in what is going on. If nothing else, it gives us something to talk about on the air which, from what I'm hearing these days, can't hurt.

—Wayne.

AUSTRALIA

Jim Joyce VK3YJ
44 Wren Street
Altona, 3018
Australia

VK5—JAW'S HOME TERRITORY

Jaws, or The Great White Pointer Shark, has a reputation in most parts of the world for being a large fish, but in VK5, around Port Lincoln, world fishing records involving sharks have been broken time after time. There have been skeletal remains of the Great White Shark in this area recorded as being up to 60 feet long, and some fishermen swear that they are still around at near this length.

There is, nearly every year, some sort of White Pointer attack in these waters. Keep the above in mind as you read the following from Carol VK5PWA, the current president of LEPARC, giving a rundown on their Club Activities for this and next year. They offer an open invitation to call in on your way to the America's Cup, and will welcome with open arms any Americans, especially those from Orange, Texas, their sister state.

They are holding a Hamfest from October 11–13, with all the usual activities, with an added bonus of a trip at the end, for those interested, WX permitting, to the Dangerous Reef, the home of the world's White Pointers.

LEPARC—by VK5PWA

The Lower Eyre Peninsula ARC was formed in late 1978 and over the past years has grown to a membership of 25. Our early meetings were held in members' homes, but with the formation of the local State Emergency Service (SES), we were able to use a room in their building.

We helped them erect towers for joint use and we obtained our first lot of equipment with the help of the local Lions Club. However, within a few years the SES operation became much bigger than expected and we were asked to find alternative accommodations. Our local Council offered us the use of land adjacent to the SES compound and offered us a loan of $1,000 to help us establish our facility. We were fortunate in obtaining a caboose for our radio shack, and two disused guard vans for our workshop and storeroom.

We also acquired a 20 by 24 shed—donated, provided that we move it from its site! In March, '85 the concrete slab for the floor was laid, and Easter Monday found all hands on deck to stand our "new" building up. This structure has now been lined and the ceiling has been installed, together with an overwhelming number of power points. This room was unofficially opened with a flagon of port and paper cups at our June Meeting.

During late 1984 it was decided that as a club we should consider a special project for 1985, the joint celebrations of the WIA and International Youth Year. After discussion with some interested students, their schools were asked if they would like to have amateur radio as an elective choice for 1985. Naturally, we were almost killed in the rush, but we decided to limit the groups to 10 per class. The end result was two groups of year-10 students at Port Lincoln High, and one group of year-9 students at St. Joseph's Convent.

Term 1 was pretty solid—video tapes, lectures, and on-air sessions during the 11-week course. Term 2 has been workshop sessions, recognizing, testing and sorting components. They have also started on a construction project in two parts:

Part 1. A two-valve reaction radio receiver suitable for listening to broadcast and SW bands up to 30 MHz.

Part 2. Novice valve transmitter—CW+AM—to be assembled as a supplement of Part 1.

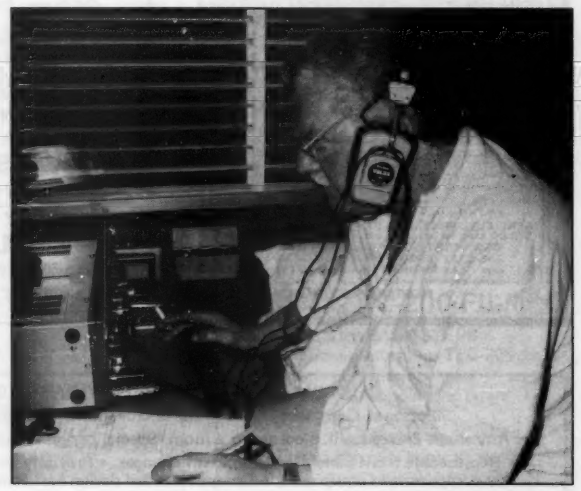
A prototype to receive 80- and 40-meter bands has been constructed and, although lacking in agc, was able to resolve all signals heard on an FRG7 receiver for those bands. Students will also take part in the forthcoming contests as 2nd Ops.

Term 3 will be more theory and, after the exams in November, the high spot of the year will be an expedition to Boston Island, a nearby offshore island. Equipment to be used will include the rigs built by the students and an early model rig built by Alf Treager (the father of outback pedal radio). Other equipment will also be used to fill out band coverage and thus ensure plenty of contacts.

The venue and dates still have to be confirmed as we are experiencing quite a number of problems. These are not new to anyone who has tried to organize a similar venture.

We have the support of the South Australian branch of the WIA and we have applied to the Department of Communications

Amateur Radio Live Across The Nullarbor—September 12, 1985. The Goldfields Amateur Radio Group (Kalgoorlie, Western Australia) welcomes V15JSA Railway Mobile. From the left, VK5AQZ (project coordinator), SWL 60370, VK5ZN, VK6ZGQ, and XYL Susan, VK6ZX and XYL VK6KYL, and (hidden) VK6ZAJ. Photos by VK5BPA.



Amateur Radio Live Across The Nullarbor—September 15, 1985. Graham Horlin-Smith VK5AQZ hopped out of his berth when the bands opened. (See the March, 1986, issue of 73, Australia column, for the story.)

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for a special callsign, VI5IYY (International Youth Year). Between bouts with all this radio activity, the students are trying to come up with a suitable QSL card and T-shirt design. The Commonwealth Bank of Australia will sponsor the QSL cards.

So, listen out over the next few months—you may hear some of our prospective hams calling: "CQ, CQ, CQ—VK5ALE VK5ALE VK5ALE—Second Opp Calling."

The Club has a Kenwood TS-520 rig, a 2m rig—and our RTTY machine is almost on air. Signals received do not have enough audio to be resolved on our Seimens Machine; we're busy doing a few adjustments, so it's really close to being "on-air."

We also have a bit of home-brew gear, including the ATU in fulltime use at the club. Antenna system includes Slim Jim and beam for 2m and a trapped dipole for other frequencies. We are working on a hat to load one of our towers as a vertical on the low frequencies.

Further club activities include a weekly club net on 3.560 (plus or minus QRM) at 0830 UTC on Fridays, plus a slow Morse session for VK5 division of the WIA on Monday nights.

If you are interested in a stopover or want further information, please write to LEPARC, PO Box 937, Port Lincoln, Australia 5606.

Kirsti Jenkins-Smith VK9NL
PO Box 90
Norfolk Island
Australia 2899

NORFOLK ISLAND

We knew we were playing for time back in 1976 when the powers that be decided to install an FM transmitter in the Norfolk Island broadcasting station.

"You won't need AM," they said. "This is a big step forward, keeping up with modern technology," it was maintained. Naturally, the people who made all the decisions (and still do) know little or nothing about SWL eager beavers and other interested persons straining to hear the elusive signals from VL2NI.

Some time during the second half of November, 1985, time ran out for AM broadcasting on Norfolk Island. The AM transmitter had ceased to function. The authorities did try to do something. They telephoned Papua New Guinea to talk with Jim VK9NS/P29JS to see if there was anything he could lend them in the way of equipment.

Personally, I do not think an amateur rig suitable for prolonged broadcasting, but then I am not a technical person. In any case, there was nothing Jim could do in the circumstances, and in a QSO with VK9ND on Norfolk Island, I learned that it had been decided to forego AM broadcasting from now on. So there we are. If you can't hear them on FM, you can't hear them at all.

Another leap up and away was the Aussat satellite which is now in place. So now there is only a dish standing between regular television and hardly any TV. Because it was possible to receive TV even before Aussat.

Jim and I used the six-metre beam for antenna, and during the summer months, TV pictures would come in in a ghostly sort of way: pictures fading in and out with two or three different stations intermingling. This interplay between stations could at times be quite hilarious. Best remembered is the voices of politicians seriously discussing a news item. The picture, however, showed muppets sitting around a table discussing something else. The scene was perfectly synchronized. The words of the politicians matched the movements of the muppet mouths to a tick!

Best TV program I have seen for years. It is doubtful if the satellite will provide good entertainment like that.

Amateur radio activity from Norfolk Island declined in November with a further 25 percent (myself) leaving the Island temporarily, the weather until then had been good for sitting inside playing with the radio. It rained almost every day from February onwards. And it blew.

The storm moved the beam so that the headings were all wrong. Not being crazy about climbing towers, I made up new headings on a piece of cardboard. The beam was roughly 135 degrees out. Africa? Where had Africa got to these days? Ah! There it was, up where the U.S.A. used to be. The U.S.A. had moved down to the Antarctic.

I was just beginning to get used to the new headings when a new storm moved the beam back to 45 degrees out. New headings. New confusion. I think Welikovski must have had a finger in the pie.

What with poor propagation and crooked paths in 1985, it hardly mattered. With so little activity and no AM broadcast, Norfolk has nearly slipped back into the dark ages, when few people knew of its existence. However, it does exist, Brigadoon-like. Sunning itself in cool temperate breezes out there in the Pacific.

The year 1986 should bring new awakening. Jim will be home to climb the tower. So we should emerge from the dumps of the sunspot cycle with Norfolk Island geared to communicate with the outside world once again.

CZECHOSLOVAKIA

Rudolf Karaba OK3KFO ARC
Gogol'ova 1882
955 01 Topol'cany
Czechoslovakia

UHF

During the contest "SNERA" that has been organized together with the magazine *Radio* and the Department of Communication of the USSR, the competing stations registered seven days in the course of July, 1984. During these days, polar glow with radio effects occurred. In August, 1984, there were eight and in September, 1984, as many as 14 days. UA9AAZ was listening to the station SM4GVF in the 145-MHz band at the distance of 2300 kilometers and RA3AGS was listening to the station PA and GM in the 433-MHz band.

RS1

(Radio Soviet ORBIT) According to the assertion of UA4FP, telemetry of the beacon RS1 in the frequency of 29.401 MHz can be heard from time to time. The directing centre in Moscow tries to also put the converter into operation but for the time being it was not successful.

SHORT WAVES

Every month in Czechoslovakia there has been organized a state contest in the band of 160m. The contest is organized for the increase of an operator skill under the title "Test 160." It is devoted mainly to young operators OK/OL. It lasts one hour by operating CW. In February, 1985 the first three places were occupied by these stations:OK1DWA—2,604 points, OK3CZM—2,552 points, and OL1BIP—1,825 points.

DXCC STANDINGS

The best stations in Czechoslovakia to March 10, 1985 (first figure, DXCC land confirmed, second, old DXCC): Mix (CW + Phone): OK3MM—315/355, OK1ADM—315/346, and OK1MP—314/345; CW: OK3JW—298/302, OK1TA—295/301, and OK3EY—295/299; Phone: OK1ADM—314/340, OK1MP—313/339, and OK1TA—310/325.

The champion of Czechoslovakia of collective stations on UHF for the year 1984, in which the results of the biggest European races on UHF are being included. became the radio club OK1KRG from Prague with 131 points; next were OK1KIR with 110 points and OK1KRA with 100 points, also from Prague, evidence their exemplary devotion to work on UHF.

RTTY

OK1VXO-OK1VVM have put into practice RTTY by using the micro computer ZX-81. The circuit of the contact between the computer, reception converter and generator AFSK is fit with the circuit MHB 1012, MH3205, MH7400, NE555. The program was worked out by Jirko OK1VXO.

From OK1JT I received further information on his experiment with the ZX-81. He uses the teletypewriter RFT only for the recording of the received relations. He assures the transmission by means of the micro computer and the program. For the interconnection of the computer, teletypewriter, tape reader and converter with generator AFSK, OK1JT uses the circuit of the contact according to OK2BFS. The operation program in the language Basic, that was elaborated by OK1JT, assures automatic transmission of calls, various texts from memory prepared in advance, printing of QSL sent by air, and, of course, transmission of the texts from the digit key strip ZX-81. OK1JT had no problems with mutual interference of the transmitter and the computer.

Annually the honoring of the best Czech and Moravian radio amateurs takes place. Late in January, 1985, the best radio amateurs meet in Tisnov to receive the prizes for their many years of service. The evaluation was done on the basis of the vote of the members of the Czechoslovak Central Council of radio amateurs.

The first place was occupied by a twofold world champion in radio

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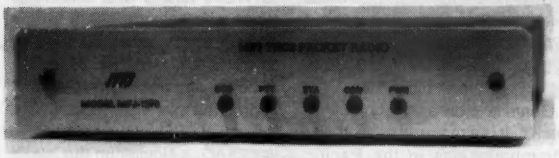

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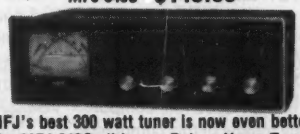

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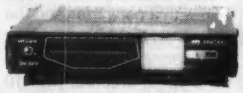

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orientation races and a master of sports, Eng. Mojmir Sukenik with 270 points Pavel Sir OK1AIY received 183 points for his work on UHF and in third place was Eng. Karel Karmasin OK2FD for his work on short waves, with 166 points.

CONTESTS

In the VK/XL RTTY DX Contest, 1984, three Czechoslovak radio clubs achieved perfect placements in the category of collective stations, with multi-operator. They occupied the first three places in the world in this sequence: OK3KJF–110.000 points, followed by OK3RJB and OK3KXJ.

Besides that, listener OK2-21478 won the first place in the world of SWLs.

RTTY

Station OK1DRX not only improved its program for RTTY by means of a ZX-Spectrum computer, but by means of this computer made contact in the 145-MHz band with OK1VAT.

AMSAT OSCAR 10

Since the end of April till the beginning of October, 1984, Jenda OK2EH, by operating CW, made 150 contacts with 56 lands according to the DXCC list. He has been using electronic equipment of a multiplier type with electron tube REE3OB. The receiver is MWEc with a converter and the antennas are 12-element yagi for the reception and a 15-element yagi (or a spiral antenna with 10 threads) for the transmission. Both of them are revolving in both levels.

Radio club OK1KRA wrote that they had been working with the following Czechoslovak stations: OK1AIY, OK1KHI /p, OK1DIG, OK1KTL/p, OK1DKS, OK1DTL, OK2AQK, OK3AU and OK3RMW. Station OK1KRA is the first station from Czechoslovakia and the first one of the socialist states that had been working with 57 DXCC lands.

Some remarks made by OK1VPZ:

(1) It is necessary to listen perfectly, the antenna, 16-element yagi F9FT, or 2 by 9-element yagi F9FT crossed for circular polarization, with a preamplifier.

(2) Since there is an output of 20 Watts in the MHz, we have exactly the same as we need.

(3) As for the mentioned antennas, it is necessary to have exact prediction of the position of the satellite. It is best from the computer.

(4) If the signal of the computer is not strong enough, we call only weak stations, because if they have weak signals, they hear themselves and also us.

Over one and a half years, Ondrej OK3AU made in mode B about 2,500 contacts with 67 DXCC lands. Besides that, he had been working occasionally under callsigns OK5MIR, OK5KWA, and OK0WCY. Ondrej confirmed a sad reality—that unnecessary overloading of the converter in mode B has not been changing for the better. On the contrary, the number of stations using enormous erp outputs to the radar values in spite of improving their receiver system, has increased.

Vlasta OK2VPA from Opava has been also working through AO-10/B where he has made 100 contacts. She appreciates most the contact with the station VS6XLA from Hong Kong.

SATELLITES RS

At present, during the period of the quiet sun, there are good conditions for the work via satellites RS. At the beginning of 1985, OK3AU, OK3FH, and OK3ZFA were working regularly on them. Also stations from Bohemia and Moravia, OK1DJW, OK1BMW, and OK2AQK appeared. From time to time some unique stations with special prefixes EU, EO, EW, EV, station UA0KAJ from Kamchatka and the stations JW from Svalbard can be heard.

Michal OK2BXF from Brno made contacts with 28 DXCC lands through satellites RS. He made some contacts with erp-5 Watts (RS5). He heard himself back with 15 Watt erp, by means of today already outdated satellite RS6.

According to unofficial information, new satellites RS9 and RS10 have been successfully tested in Kaluga near Moscow. The satellites are equipped with two converters, 145/29 MHz and 21/29 MHz.

GUAM

Edward L. Campbell KB6DAW/KH2
300a Rendova
APO San Francisco CA 96334

I thought I would write a little about the Island in this column, with a little on the lifestyles and some history.

Guam is a small island, 30 miles long by 12 miles wide—about 225,000 acres. It has a population of about 175,000 with 20,000 being transient with the military.

Guam is know as the hub of the Pacific. It is a major link to satellite communications in the Pacific with a NASA tracking station. Guam is 6,000 miles from Los Angeles, 3,644 miles from Honolulu, 3,500 miles from Singapore, 3,000 miles from Manila, and 1,550 from Tokyo.

Guam has two types of seasons, wet and dry, the wet season being from July to December. Guam's average temperature is 86 at its high with its low being about 75. The yearly rainfall is about 85 inches. During the rainy season, Guam is lush and green.

The highest point on Guam is Mt. Lamlam (1336 feet), in northern Guam, with undisturbed jungle.

At the north end is Andersen Air Force Base, and at the southern end is Apra Harbour and the main Naval Station. Speaking of the southern end, there is a small island known as Cocos Island. It is about 2.8 square miles and is a large tourist attraction with a hotel and sandy beaches. It also has a small zoo with tropical birds and other wildlife.

Guam is part of an underwater mountain chain that includes Japan.

The people of Guam are a mixture of Chinese, Japanese, Koreans, Filipinos, Micronesians, and of Spanish descent, and also us statesiders. The Guamanian people are know as Chamorros (the women are Chamorritas).

Guam, after many years of rule by the Spanish, became a US Territory, after the Spanish American War and the Treaty of Paris, 1898. In 1950, the Chomorro people were given their citizenship by Congress. In 1971, Guam elected its first delegate to the US Congress.

Guam is a duty-free place for tourists, with some of the prices being 50% lower than stateside prices.

There are about 100 hams on Guam, with many not active. Sixty are in the Marianas Amateur Radio Club (MARC) of which I am the secretary.

To finish up, the island is a laid-back type of place with lots of water sports, good prices for the shopper, and pretty decent propagation for the DXer. So if you get the chance, come by and see us.

Here are a few lines on my trip to Wake Island and thanks to those who helped: P29JS for the vertical and headset donated by the HIDXA and the 220 net; AH9AC, who helped me plan and coordinate plane schedules and the use of some of the equipment; WH9AAD, a Novice on the island who was in charge of the "motel" there, who made sure that I had a room to myself; the communications officer who allowed me to use the facilities; of course the Base Commander, Maj. Westmoreland, who gave me permission to visit there and who might try to help me with the next trip next year; NK6T for the use of his rig during the CQ WW while he was off to Japan, and KC6RM for his help putting up the vertical for the lower bands—and his technical work on the rigs to keep me up on the air.

My call has been changed from KB6DAW/KH2 or KH9 to AH2BE, which will be AH2BE/KH9. That will make things a little easier since it is shorter.

Now all in all, I made 6,200 QSOs. 122 countries, all the states, and all but 4 zones. So not too bad with only 7 days on the air. The first two days were getting the rigs and antennas up and on the air, so that the following days would be nothing but air time. I did not have an external vfo so a lot of the 40-meter split work was by running back and forth from 7.085 to 7.195 on one vfo. It was slow but it worked.

Mostly I used an FT-101b that I borrowed from KC6RM; I finished up with a TS-830S. The 830 had some receive problems—that is why I used the other rigs. Gary NY6M was supposed to go, but he made a stripe and his officer had other orders for him, so he could not go. I had to go by myself. Next time I will make provisions for that and have two people in line to go with me. If Gary had been along, we would not have left so early and could have doubled the number of contacts made. But all in all, the trip was a success.

Propagation was excellent to all areas except Europe. I hope the next trip will be more fruitful for them. I am also planning to do a two-band-a-day-only schedule so that each band will get as much time as possible. And also hoping to get up on the top band so that 160 will get some attention.

Anyway, I got on the island on the 23rd, their time. After about an

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hour I was on the air. My first contact was HC8E. Not a bad way to get started! Then checked in to the 220 net. It was open long path to Europe at that time, and had problems staying on the net because of the QRM.

After the net I went to the 7.085 net with Eric ZL3AAG, but the band was very noisy—as was 75 meters. In the Pacific, the lower bands are very noisy as a whole. My best two bands were 20 and 40, though. As the days progressed I did also the QSOs. I was always in a pileup which made it hard to call some of the stations that I needed. My country list would have been greater otherwise.

I left on the 31st of October on a plane on its way directly to Guam. My voice was gone. I was getting only five hours of sleep a day. (Except after the contest, then I slept 18 hours.) I worked all but four hours of it. AH9AC did that part for me.

Now I did have some fun. I had a four-day stopover on KH6 and worked a few people on 2 meters. I did not know there were so many repeaters in such a small place HI HI HI. . .

Also while I was enroute, there were some interesting things happening. It just so happens that the same month was the 50th anniversaries for Amateur Radio and the first China Clipper flights from the states to the Far East. So lots of celebrations on the island. So for amateur radio it was a small milestone.

For those I made contact with, I hope you have sent for your cards for this event. If you haven't, please do so as soon as possible. I will be packing my bags to go to HL9-land soon and I want to make sure that you get yours. And an SASE would be appreciated. It makes things go faster.

I have a small trip to 8P6-land planned while I am there visiting my inlaws. My father-in-law is 8P6JQ. I will be as active as possible from there. I hope to have an 8P9 call. You will find me on the PHO net or the 220 net with P29JS—or should I say VK9NS?

I am trying with the help of HL9TW or HL9CW to have my HL9 call before I leave Guam so that I can get out the word in advance. I hope to get HL9MM. And am still planning to return to KH9 next year.

As of this writing, almost three years as a ham, I have contacted over 230 countries with 195 confirmed. And I hope those I have sent cards to will return them to me as soon as possible so I can put them in for my DXCC.

GERMANY

Ralf Beyer DJ3NW
Opferkamp 14
3300 Braunschweig
Federal Republic of Germany

SPACELAB-D1 MISSION

In November, 1985, space shuttle Challenger carrying the German Spacelab-D1 mission landed again. But even today one cannot fully assess all the outcomes of this mission for the amateur-radio community.

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Astronauts were Reinhard Furrer DD6CF, Ernst Messerschmidt DG2KM, and Wubbo Ockels PE1LFO. Here are some of Messerschmidt's comments. Regarding his amateur-radio activity in space, Ernst said: "I think I made only a quarter hundred QSOs because of the immense program of work we had to do. The transceiver was just sitting there and I had a chance to hit the button when only I passed by. However, I enjoyed it very much that every time I turned the radio on someone was calling us. Even over the Pacific. I asked someone from the space shuttle crew whether he would see any land or island—but no. Probably the call came from a ship out there."

Regarding the pileups, Ernst commented: "Of course, the pileups were roughly proportional to the amateur radio population of the area we just flew over."

A demonstration of what he was talking about was a tape recording which was incomprehensible sometimes due to the European QRM. But some minutes later, it reproduced the only voice of a station calling from South Africa, and nothing else. A total of 12 hours of tape recording was brought back.

Unfortunately, the astronauts did not manage to get in contact with DP0GVN, the German amateur radio station of the Georg-von-Neumayer base in the Antarctic. The station was operated by Lothar Baumann DG5SL, at that time—who can be heard regularly via OSCAR 10 and who tried hard to catch the Spacelab station. Better luck next time!

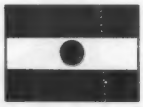
Ernst's comment on the importance of amateur radio in space: "Every time I heard the voices calling us I had the good feeling that we were still in contact with someone on the ground. I consider amateur radio a great leisure activity, in particular for the personnel manning the first space station in about 10–12 years from now. Another aspect is to think about amateur radio activity from an orbiting space vehicle via geostationary satellites. That could keep us in contact with all continents permanently and would enhance our chances to set up schedules which fit better into our program of work."

The amateur radio activity aboard Spacelab-D1 received particular good attention in the media here in Germany. There were dozens of newspapers reporting from their local amateur radio station on the tracking, calling and receiving at least the beacon of the spacelab amateur radio station. The subject was also very well covered in a 45-minute TV report with truly professional recordings and film clips of the astronauts talking from Spacelab via amateur radio and of their counterparts on the ground.

Besides the many positive experiences, there were the ever-recurring problems of handling large pileups and the nuisance of stations chatting on the transmission frequency of the astronauts. A thorough analysis of the state of the art of working through conventional DX pileups and an attempt to derive procedures applicable to space communication may be worthwhile. Furthermore, the multi-channel, fixed frequency, and separate transmit/receive features of space communication may lead to completely different and perhaps more advanced solutions of this problem. Bright ideas are badly needed, in particular in the light of the Spacelab-D2 mission coming up in 1988.

"Bright ideas will always get our support, in a way we helped amateur radio to become operational on Spacelab-D1," said Heinz Riesenhuber, secretary of the German Department of Research and Technology.

All right, it's up to us again.



INDIA

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3 Thiru-Vi-Ka Road
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India

HAM AT THE HELM

Prime Minister Rajiv Gandhi VU2RG has been in power for just over a year, having succeeded his mother, Indira Gandhi, on 1st November 1984. This period has seen an extensive change in the policies of the government which have even won the grudging appreciation of the opposition. Quite a few of these are of interest to hams.

While he was a member of Parliament in 1984, Rajiv was responsible for the waiver of customs duty on amateur equipment, with a limit of Rs. 10,000 (roughly US $1,000) which was expected to cover all but the most sophisticated transceiver. The waiver was valid till December 31, 1985. Prices have been going up along with sophistication, and there are many pieces of equipment that ten thousand rupees cannot buy any more. Responding to representations by the Federation of Amateur Radio Societies of India (FARSI) and others, government has now extended the validity of the waiver till the end of 1986, and has enhanced the limit to Rs. 15,000, making it possible to bring in any equipment that one might fancy.

The Indian electronics industry had enjoyed a sheltered market dominated by the favored few who had been given industrial licenses to make electronic products. One fine day, the Prime Minister made a statement in Parliament, indicating imminent relaxation of these restrictions. What followed was a wholesale liberation of the industry from its shackles. The electronics industry has not yet responded to this move with any tangible results—reduced prices or better products. The Prime Minister recently warned the industry to take heed that Government will go to any extent to see that the benefits of liberalization reach the common man.

Rajiv Gandhi has also swerved from his mother's policies about the computer industry. At one time, Indians returning from tours abroad could sneak in computers only by making customs officers believe that they were video games or electronic typewriters. Today, one can bring in a personal computer valued up to US$300 without hassles, by paying the appropriate duty on it. The Indian computer industry (where the Sinclair/Timex ZX81 with 1K RAM once sold for over US$500) has also benefited by reduction of import duty and liberal import of components and peripherals. Almost anyone who proposes to make personal computer or microprocessor-based systems is given a license to go ahead. It is the Prime Minister's wish that computers should become as common in Indian schools and households as they are abroad.

Government has also recognized that young engineers bubbling with enthusiasm can produce dramatic results. To illustrate this concept, a centre for Development of Telematics, C–DOT for short, was recently formed with a few hundred fresh graduate engineers under the leadership of a couple of US-returned Indian engineers, charged with the development of an electronic telephone exchange. This group has, within a year, produced an excellent electronic PBX and is forging ahead towards its ultimate goal. It is likely that more such goal-oriented young-engineer projects, including amateur-radio and personal-computer hardware, will be promoted either by the Government or with its blessings, thanks to VU2RG.

JAPAN INC.—THE INDIAN COUNTERPART

A reader in the "Feedback" section of *Radio*, India's only amateur radio journal, has written "I would be happy if you include an article on how to import a rig from abroad on our own as the dealers of Japanese companies in India keep a good profit. So just to prevent their monopoly and help the hams of India, it is a must for every ham to know how to import the rigs. Some of the ham friends outside India can give us their rigs or arrange the rigs on a no profit, no loss basis.

This statement might sound rather harsh, but there is quite some justification for the reader to feel bad.

Ever since import of amateur equipment was freed from import control in 1980, local representatives of Japanese manufacturers have created an impression that used equipment is not permitted to be imported under Open General License (OGL). Five years and several clarifications later, these agents continue to din into the ears of prospective purchasers that they are not permitted to import used equipment.

Most amateurs who did not want to take chances, fell for this canard and refrained from importing used equipment, just to avoid the hassles that the doomsayers assured them were bound to bog down their rigs at the customs.

Concerned with the small number of persons who were on the air even after import restrictions were relaxed, Government went one further and fully waived import duty. The agents went into business again spreading the word that those importing used equipment will not be eligible either to duty waiver or free imports.

Not satisfied with the 20 to 25 percent commission that they get from the manufacturers, they add "handling charges," cable charges, and incidental expenses adding up to at least a further 10 percent of the cost of the rig. The fast appreciation of the Yen also gives

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5600uf 25V (Comp Grade 3-5/8" X1) 3/1.00
.1uf 50V Monolithics 10/1.00
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74SC239-1 Of 4 Non-Inverted
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74SC241-Octal Buffer/Line Driver-N/I
74SC244-Octal Buffer/Line Driver-N/I
74SC245-Octal Bus Transceiver-Non'I
74SC373-Transparent Latch-Non/Inv
74SC374-D Type Flip-Flop, Non/Inv
74SC533-Transparent Latch-Inverted
74SC534-D Type Flip-Flop, Inverted
74SC540-Octal Buffer/Line Driver-Inv
74SC541-Octal Buffer/Line Driver-N/I
74SC563-Transparent Latch, Inverted
74SC564-D Type Flip-Flop, Inverted
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PROPAGATION

Jim Gray W1XU
73 Staff

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U. S. S. R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U. S. S. R.								20	20			

WESTERN UNITED STATES TO:

ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U. S. S. R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

G=Good, F=Fair, P=Poor.

Look for some disturbances in magnetic field between 5th and 10th with possible storm levels; also possible 6- and 2-meter openings in this period. Again, between the 27th and 30th look for active magnetic field conditions and generally poor propagation on HF, LF, and VHF.

APRIL

SUN	MON	TUE	WED	THU	FRI	SAT
		1 G	2 G	3 F	4 F–P	5 P
6 P	7 P	8 P	9 F	10 G	11 F–G	12 F
13 G	14 G	15 G	16 G	17 G–F	18 F	19 F–G
20 G	21 G	22 G	23 G	24 G	25 F	26 F–P
27 P	28 P	29 P	30 P			

them the opportunity to ask for some more in the name of currency fluctuations. Airfreight adds US$120 on a Yaesu FT-757GX, the most popular import in India.

A number of amateurs ask why the Japanese manufacturers will not ship by other modes. The agents say their principals will not change their policy. Take it or leave it! And they help the swing towards "take" by adding that the duty waiver will not be extended.

It has been extended thrice, and the new deadline is December 31, 1986, with reasonable chances of further extension.

What recourse does the poor Indian ham have? It has to be conceded that amateur radio has today become an appliance operation the world over. India is no exception. If amateur radio is to keep growing, appliances have to be made available *without* the added cost of Japan Inc.'s local arm.

Short of switching his allegiance to the only US-made transceiver which has fewer knobs and features than the Japanese stuff, Mr. Indian Ham has to live with the problem and educate himself on the intricacies of the import control and customer laws and procedures. To what extent this can be accomplished remains to be seen.

LIBERIA

Brother Donald Steffes, C.S.C.
EL2AL/WB8HFY
Box 716
Notre Dame IN 46556

Ninety three and a half inches of rain in five weeks! That was the recorded rainfall in Monrovia that was reported on The West African Net early last September. Until then it had been a very *dry*, wet season! The accumulation was running more than 20 inches below the lowest records of the past four years!

The antennas were well washed but communication was bad. Even 40 meters (which is our "workhorse" band for calling up and down Liberia) sometimes goes almost to zero. DX communication was worse and we expatriots were feeling very lonesome as we talked to the stratosphere and got no answers.

In the meantime, the repeaters were working. In an earlier column I wrote about our plan to link the Monrovia and the Bong Mines repeaters. They are linked and we have HT communication from both ends. We have never had it so good.

Now Mark Munson, M.D. EL5G has come back with another repeater. Plans are under way to install that little one-Watt unit in the Zorzor area which is near the north end of Liberia and link it with the two repeaters down here. The distance is 90 miles to Bong Mines and 120 to Monrovia. If it is necessary they will use a linear and when everything is working we will give a full report in this column.

Mark is a missionary serving a 120-bed hospital in Zorzor, and once a month he travels another 100 miles to Foya to bring the service of a doctor to the hospital there. When Mark has his new repeater working it will give him regular and easy communication with Monrovia. The radio is his only means of contacting the world outside.

The amateurs in Liberia enjoy a great deal of freedom and the missionaries working in this country use it to great advantage. When they come to begin their tour of duty, the amateur license is high on their list of priorities, and the Liberia Radio Amateur Association does everything that is possible to help them.

In the States there are many nets that are organized and exist for the sole purpose of serving American missionaries or armed service personnel. They do this with great dedication and sacrifice on the part of their members. It seems to me that an article recognizing their contribution and listing the times and frequencies at which they operate would be in order. Such an article would increase an awareness of this work, and in all probability many American amateurs would offer their expertise and join one of these nets. At the same time it would serve as a kind of a directory for those that need the help of these nets.

So long as our amateurs show themselves to be responsible and use the amateur bands in accordance with the law and accepted customs we will continue to enjoy this freedom. Every effort is being made to ensure that this be done and it is a rare instance when a correction has to be made.

Note from the International Editor: Don EL2AL has left Liberia. We will miss the interesting reports he so faithfully sent us. Anyone like to fill his shoes?

HAM HELP

I am in the U.S. Navy stationed in Japan and I'm looking for a good used linear amp, 250 W and up, preferably for 10–80 meters, but I'll consider any HF amp.

AQ2 Dave Parks N4KHB/KA2DP
VA56 U.S.S. *Midway*
FPO San Francisco CA 96601

I would like to get in touch with anyone interested in starting a rag-chew net on 6m FM simplex, 52.660 in San Diego County, San Diego, North County and beyond.

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In Packet mode, the PK-64 offers virtually all the features of every other Packet controller on the market, plus many important features left out by others due to cost constraints. For example, we have included a hardware HDLC, true Data Carrier Detect (DCD), multiple connect with up to ten stations simultaneously and full implementation of version 2.0 of the AX.25 protocol.

Because the PK-64 was designed specifically for the Commodore 64 (or C-128 and SX-64) computer, we have been able to do many things not economically feasible with general RS-232 interface controllers. For example, the Pakratt includes true split screen operation with on-screen status indicators and an on-screen tuning indicator.

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WORKS WITH THE POPULAR C-64 COMPUTER

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The PK-64 is so complete that all you need to do is wire up a microphone connector to the end of a cable (provided) and you are ready to go. There is no need to track down special terminal software, cabling or even a power supply. It all comes with the PK-64. So do not be the last on your block to own the most exciting new product in years. See the PK-64 at your favorite dealer or write for our specification sheet now.

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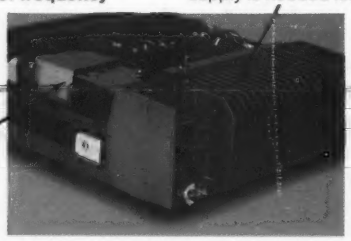

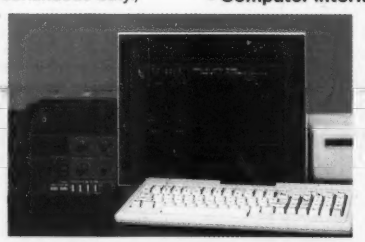

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